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Field Museum of Natural History

BULLETIN

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Field Museum of Natural History Bulletin

Volume 43, Number 1
January 1972

Cover: A bark painting from Central Arnhem Land which tells of the origin of the people in the Dreamtime, when each clan descended from a totemic ancester and human beings could change into animals and birds at will. In the forefront, men are changing into a crow, a spoonbill, and an ibis; above, a grasshopper is turning into a man. Painted by Nanganrralil, of the Djambarrpuyngu clan, Dua moiety.

2 **Art from Arnhem Land**
Louis A. Allen, with introduction by Joyce Zibro
background information about the ceremonial art of Australian aborigines

9 **January Museum Calendar**

Appointment Calendar for 1972

Field Museum of Natural History
Director E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker, **Photography** John Bayalis, Fred Huysmans.

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Art from Arnhem Land

Louis A. Allen,
with introduction by Joyce Zibro

One definition of a work of art is that it has a life of its own. That is, it has a universal appeal. It can be removed from its particular context, from the community in which it was produced, to a place where its associations, purposes, and meaning are unknown, and yet it can be appreciated. By this definition the bark paintings and wood carvings produced by the aboriginal people of Arnhem Land in northern Australia are certainly works of art. Almost 400 examples of this art are in the temporary exhibit opening at Field Museum on February 3. This largest group ever shown is from the collection of Mr. Louis A. Allen of Palo Alto, California.

However, these objects were not meant to stand alone as "art for art's sake." They have functional roles, are integral parts of the complex social and religious ceremonials of the technologically simple hunting and gathering culture of the Arnhem Landers.

Mr. Allen's collection is especially important for viewers who wish to see this art in relation to its cultural context because each specimen is so fully documented with information about the artist, where he lived, and the subject matter, style, and technique.

Art is not categorized as such in Arnhem Land society. In fact, there are no words in Australian aboriginal languages equivalent to our words "art" or "artist." Most men in these societies can paint, carve, and incise. There are usually some who are regarded as being better at it than others or as having definite rights through age or status to practice "art" or some aspect of it.

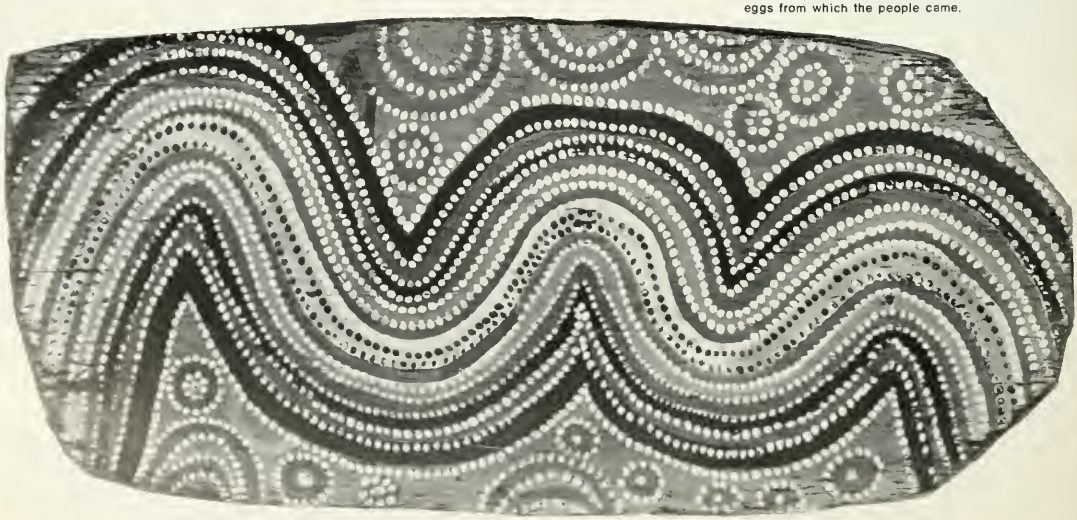
The Arnhem Land artist is confined to a set of traditional rules that determine both subject matter and design. Although the work of individual artists varies in subtle ways, individual "creative" expression is restricted.

Much of Arnhem Land art is representational, though it may vary from naturalistic to highly stylized, and in this sense abstract, representation. And it may also express either symbolic meaning or merely descriptive narrative. The art may be appreciated for just its representational subject matter—the human figures, animals, trees, or abstract designs standing for clouds, rain, and so on.

But to understand the meanings of the art, either the symbolic content or the stories told, requires special knowledge about religious beliefs and the world view of the local community. Dr. Ronald M. Berndt, Professor of Anthropology at the University of Western Australia, has pointed out, "Representational or 'abstract' art designed to convey meaning either to an entire community, or to certain categories of persons within it, can be understood only by those belonging to that society, and sharing its particular tradition. To be able to interpret the design and its symbolic significance there must be shared recognition, otherwise such designs and symbols become meaningless, or may be accorded quite different meanings. There is further parallel here with language: We can hear the sounds, but unless we know the language we cannot hope to understand those sounds, to derive meaning from them."

Appreciation at this level constitutes understanding the art as a medium of communication within the community.

The rainbow snake, painted by Indi, Port Keats region. Many tribes of Arnhem Landers believe in a great snake as the progenitor of their tribe. The circles represent water holes and the white dots the eggs from which the people came.



Kangaroo being hunted by a Mimi spirit. Painted by Nguleingulei, Western Arnhem Land, in the "X-ray" style showing internal organs.

These meanings might be revealed only to certain members of a particular community. For example, certain designs may be seen only by men and not women, or only by men of certain categories. Or the meanings of certain designs, or different meanings of some designs, may be revealed only as a person progresses through age-grading rituals, or as his social and ceremonial position in adulthood changes.

Louis Allen refers to "inside" meanings, which are sacred and secret, and "outside" meanings, which can be told to anybody. It is because he was so successful in communicating with old men of the tribes about the different levels of meanings expressed in individual pieces that we have such abundant information about the specimens in the exhibit.

Some art critics have suggested that nonliterate peoples are especially adept at handling and understanding symbolic statements through nonverbal as well as verbal ritual, which sets them apart from the literate world as people who think "mythically." Berndt argues that this is not so. "Our own language and our art," he says, "contain an abundance of symbolic allusions which is part of our traditional heritage as Western Europeans, and this is much the same in Arnhem Land or elsewhere." He says that it is not merely a question of nonliterate as contrasted with literate. Some people have more, some less symbolic allusions in their art, and the development of scientific precision or growing emphasis on technology has no specific influence one way or the other.

Besides art being a form of intentional internal communication within a society, it may be viewed as a form of unintentional communication about the society as a whole to those outside. Berndt has suggested that because sex differentiation, social and ceremonial status, and prestige are all involved in how the art is produced, used, and understood by different people in Arnhem Land, our studying these contextual contingencies can tell us something about social organization within the society.

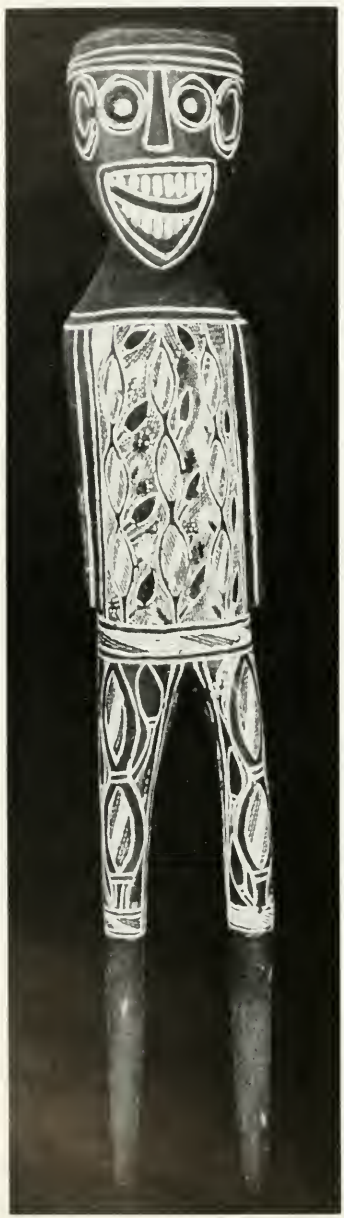
Berndt believes we may also be able to learn through the art something about social variations from one region of Arnhem Land to another: "Art, whether naturalistic or stylized, is always an abstraction from reality—from the empirical situation; it is a statement about something, expressed in a specific way, and the ways of saying it vary as do languages and other aspects of culture generally. But within a particular society, although variation takes place through time as well as through the growth of 'schools,' an art style may provide us, in abstract, with a 'key' to the value orientation."

For example, in considering Arnhem Land bark painting, Berndt points out that the techniques and mediums in one part of Arnhem Land do not differ radically from those in another part, and, with few exceptions, the subject matter does not differ either. But there are noticeable contrasts of style.

The Western Arnhem Land artist usually does not attempt to cover the complete surface with design. His subjects stand out boldly against an open background; and generally he selects fewer features for illustration on any one bark than does his counterpart in the east. He concentrates on the main figure or figures rather than on the setting and subordinates any detail to the main design. The subject matter includes human beings and animals in action. The eye tends to focus on these individual figures, giving an impression of suddenly arrested motion. This tendency, suggests Berndt, has possibly led to an emphasis on relatively naturalistic figures, with a minimum of stylization.

In contrast, the Northeastern Arnhem Land artist usually attempts to cover almost the complete surface of his sheet of bark with design, leaving almost no open space. In the northeast, the main designs receive careful attention, and there is considerable detail, but there is not generally the delicate treatment that is so apparent in the west, and the background is usually filled with crosshatching or crisscrossing of lines. As much as possible is crammed into this background. Again in contrast to the west, there is little in the way of movement or action in design. There is a tendency in the east to repeat both central and subordinate figures, as well as minor motifs, giving the effect of a pattern, such as European-type textile design. Where such figures do stand out from their backgrounds, this is achieved by the use of

A rangga, or sacred carved figure. This one was used in the Djalambu ceremony, one of the cycle of death and burial ceremonies of the Gupupuyngu people, Milingimbi region. Height, 39 inches. Artist unknown.



contrasting colors of outline, or by filling them, whereas in the west both this technique and spatial separation are used.

Naturalism is played down, so to speak, in the east with a corresponding concentration on stylization, and symbolism is expressed in varying degrees of complexity to suit a society that is hierarchically graded in respect to religious knowledge.

Allen suggests that one reason for the development of contrasting styles in the east and west is that the west, especially in the Oenpelli region, is inaccessible to water navigation and thus the art style, which is similar to that found in the cave painting in the area, believed to go back 10,000 years, has remained uninfluenced by foreigners.

Art in the east has been influenced by the Macassans who came regularly from Indonesia in their great praus over the centuries to trade with the Arnhem Landers. The background on the designs in the east, says Allen, is a modification of the Macassan designs, and led to the development of a more detailed style of art.

If Berndt's premise is valid that art style may provide us with a "key" to value orientation, then a study of these contrasting styles of east and west may someday shed some additional light on the relation of the social and cultural situation of the two regions.

But there are some things which are readily apparent about the people from their art. Allen sums it up this way. It tells us three basic things about the people. (1) They have a deep and abiding faith in some supernatural being who created them and this belief is part of their everyday life. (2) Culture heroes taught them the basic rules of living—to be honest, avoid incest, not to steal—and they hold on to these values. (3) It is a stable and workable culture which gives guidance from generation to generation living in a very severe environment.

In order to provide our Museum visitors with an introduction to the exhibition of art from Arnhem Land, we print excerpts from the comprehensive catalog to be published by the Museum. It was written by Louis Allen, and includes an introduction by Field Museum's curator of primitive art and Melanesian ethnography, Dr. Phillip Lewis, who is in charge of the exhibit.—J. Z.

Arnhem Land has been populated for thousands of years by aboriginal tribes who have preserved their culture relatively unchanged from the Stone Age to modern times. Only in this generation is the transition to a modern, industrialized society being accomplished. There are still alive and active old men who were fully indoctrinated in the ancient traditions and ceremonies and maintain them with some vigor today. From them comes our knowledge of the myths and the significance of the bark paintings, carved figures, and totems.

Although the tribes of Arnhem Land differ in language and local traditions, they share many common cultural traits. The family is the basic living unit; the most important tribal groupings are the clan and moiety. Members of each clan believe they are descended from a common totemic ancestor—a mythical being who assumed animal or human form in the Dreamtime, the time before humans as we know them today appeared. These totemic ancestors created the first people of the clan, together with their songs, dances, and totemic designs.

The clan was the cohesive grouping around which aboriginal family life centered. Each totemic ancestor from whom the people of the clan were descended has its own sacred water hole, where this being lives to this day.

Mortuary rites for Gurrumurringu, the great hunter, painted by Malangi, Manarrngu clan, Dua moiety, Central Arnhem Land. The corpse of Gurrumurringu, in the center, is surrounded by three men who are performing the death rites. The four small figures are performing mortuary rites, which occur about twelve months after the death rites. The small scale of the figures denotes the passage of time. The spirit of Gurrumurringu is recognized as the ancestor spirit of the Manarrngu people. The story of his life and death is sung whenever a member of the clan dies.

To the sacred water hole return the spirits of the dead and from it they are reincarnated by entering a woman's womb. Each clan and its members belong to one of two moieties, the Dua or Jirritja. Each moiety has its own special myths, totems, songs, ceremonies, and even colors and materials. Strict rules apply to relationships between members of the moieties, especially to marriage, which is forbidden within the same moiety.

Each clan has its own territory, which its members rarely leave. The people are intimately familiar with every rock and tree; they know where to dig for tubers and roots, where to find game and water in even the most inhospitable regions. Outstanding features of the terrain, such as odd-shaped rocks, large trees, and water holes, were given names and invested with a personality of their own, for this is where the mythical ancestors had lived or accomplished their exploits in the Dreamtime. Because he believes his own spirit must return to its totemic place within his clan territory, the aborigine finds it difficult to leave his land and unthinkable that he should die elsewhere.

The artists often painted on bark their impressions of the sacred places of the clan; especially their interpretations of the water hole and its surrounding country or the artist's "dreaming" of it. These paintings were displayed and explained to initiates or were made part of ceremonies which centered about the activities of mythical personages at these locations.

Two themes predominated in aboriginal life: the search for food and the observance of religious traditions. From wet season to dry, food was alternately plentiful and scarce. Every able-bodied person, from child to elder, was proficient in searching for edible roots and bulbs and hunting birds and small animals. The older boys and men stalked wallaby and kangaroo.

Religion was not an observance on special occasions, but an integral part of daily life. Like other religions, that of the aborigine was based on a belief in the supernatural. He believed that spirit beings had formed the world, had populated it with living creatures, and had established the rhythm and order of life. These spirit beings had forbidden such acts as theft, incest, and adultery, and these must be avoided or evil would befall the offender. When confronted by forces beyond his understanding and control, the aboriginal trusted his spirit ancestors to shelter and protect him.

To the aborigine, the Dreamtime beings were alive and everywhere present. They lived with him now as they had created his forefathers in the beginning. They would reinvigorate his powers when properly invoked and would protect him from his enemies, both mortal and spirit. When they hunted or made love, gave presents or sought revenge, the aborigines were continually aware of the invisible, but to them very real, beings, who commanded the events and who must be both trusted and served.

The styles and designs found in the paintings of Arnhem Land have developed over many centuries. Paintings of totems and sacred objects were first made in the caves and the bark huts during the leisure time of the wet season. The bark sheets forming the ceiling of the hut were painted, the artist lying flat on his back.

The artists of the aboriginal tribes were selected and taught their craft by the old men. Each clan and moiety owned specific myths and designs and these were passed on from one generation to the next by the artist. A remnant of what will probably be the last generation of fully initiated master painters is still alive today. The older men take as apprentices one or more younger men and teach them to paint the secret and sacred designs in the authentic tradition. The apprentices

The creator mother myth painted by Mangrinyin, Gunwinggu tribe. She is shown with her two dilly bags and her digging stick.

inherit the stories and patterns of their mentors, and acquire the right to add increasing detail and significance to their paintings as they complete the proper age-grading ceremonies. The apprentice is limited to two colors at first, but as he advances in tribal stature, he can use all four colors. While the master painter is still alive, the learner is required to paint each design with some distinctive difference, acquiring rights to the full design only upon the master's death.

The aboriginal artist tends to think and talk in terms of separate incidents—the things that happened—and not abstract ideas. His stories, songs, and dances deal with individual occurrences, linked in sequence. His speech is a series of statements, not a flow of narrative. For this reason, his painting also shows a series of incidents, rather than a full story. The bark paintings serve both as history and textbooks. Often the boys who are to be initiated are grouped in a circle around the bark and the story is recounted to them. This is one reason the barks usually can be read from all sides and significant incidents are repeated.

When he paints, the aboriginal artist first thinks out the story he will depict. Often, he selects one part of the myth to be celebrated or one group of totems. He does not sketch or rough-out, but starts at one end or side of the bark and works across, filling in his outlines with patience and deliberation. If his bark is too small to depict the full dimensions of the figure, he will foreshorten or elongate; if a line is not to his liking, he removes the wet ochre with his thumb and wipes it off on a stone. If he wishes to add emphasis, he may repeat the same figure two or even three times. Although he does not set out to create an esthetically pleasing object, the finished product always has harmony and balance; the colors blend; the proportions are pleasing. In this, the aboriginal artist fulfills the basic test of real art: the beauty of his work results from his expression of the meaning of what he wants to convey—not merely from the manipulation of line and color.

The materials used in painting are indigenous to the area. The bark sheets are stripped from a tree, *Eucalyptus tetrodontus,* colloquially named the "stringy bark." The brushes are made from human hair, feathers, or chewed twigs. The paints are mixed on a stone palette with water and a fixative of orchid juice. Four colors are used: white is pipe clay or kaolin; black is made from charcoal or manganese oxide; ochres provide yellow and red. The styles of painting are quite uniform within each geographic region; however, there are stylistic differences among the regions.

To the aborigines, their myths are true and sacred stories which explain their beginnings and their history. The myths tell of the creation of the world and its creatures; the origin of birth and death; how the seasons began and why there are stars and sun and moon. The mythical heroes created all these, together with dances and songs now used in the ceremonies. They decreed how the people must act and the rules they must follow to avoid injury and suffering.

The aborigines believe that the spirits of the Dreamtime must be called upon regularly to renew life and power, to ensure the increase of species, to make the women prolific and the children strong. The spirits were invoked in the great ceremonies, such as the Wawilak and Djanggawul. They returned physically—their voices were heard in the didgeridoo, the bull-roarer, and the Ubar drum—so they could protect and aid their people. To gain strength and stature, each man had to learn how to communicate with the spirits and to enlist their support. He acquired this knowledge by passing through the different age-grading ceremonies. He became more powerful as he learned the secret songs and dances and was told the inner meaning of the totems, barks, and sacred places.

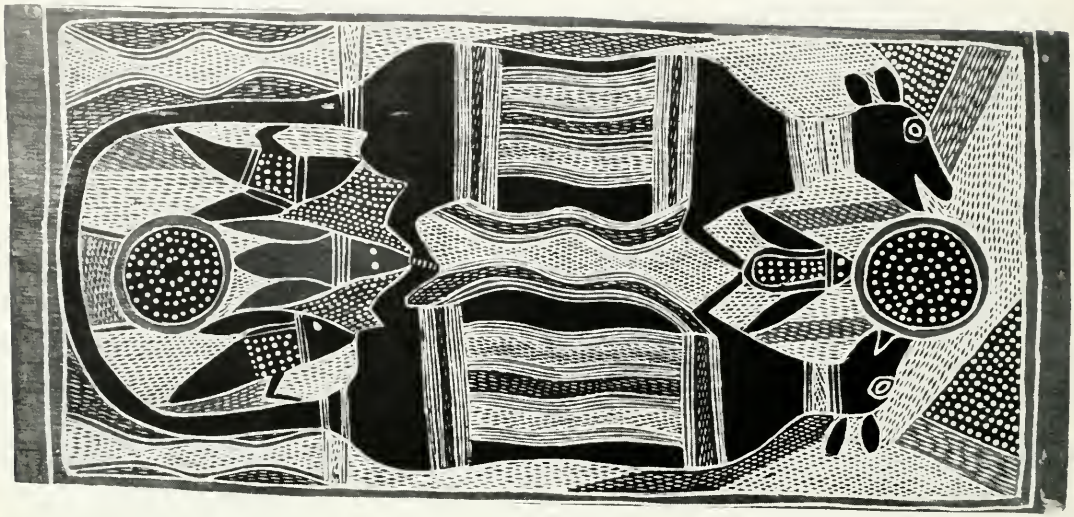
Certain myths are found among many of the clans and tribes, while others are localized to specific tribal groups. The two most important myths are the Wawilak and the Djanggawul, which tell of the travels and exploits of Dreamtime personages who created the land and the people.

The aborigines of Arnhem Land believe that the land and the features of the natural environment were created by supernatural totemic

Stripping bark.

Nanyin painting a bark depicting the opossum tree myth.

The opossum tree myth painted by Narridjin, Mangalili clan, Northeastern Arnhem Land. The myth tells the story of a lonely bird, Karawak, and how he found his friend, the opossum, to talk to.



ancestors. Prominent landmarks are associated with the great myths; for example, a large boulder may be one of the Dreamtime creatures who was turned to stone; a river was created by a crocodile who chewed his way through a mountain. The stars and constellations were also created by the Dreamtime beings. The moon was once a mythical hero, the Milky Way, a great river in the sky.

The aborigines believe that the wet and dry seasons first began because of the actions of the totemic ancestors, who also created all the animals, birds, and other creatures. In some cases, such as the flying fox and the whale, these creatures were once human; in other instances, such as the goanna and the bush turkey, they existed in their original form, but were named by the creation ancestors.

Since totems are an integral part of the ceremonies and are used in magic and in daily life, the story of the origin and powers of the totems is featured on many of the barks. The totem may be the primary theme—either in a sacred or secular role—or it may be shown in the background or associated with one of the primary figures of the design. Some totems are shown in a conventionalized manner; for example, a narrow rectangle may represent Yurlungurr, the sacred python. These symbolic representations can be recognized only by the initiated. Most totemic figures, however, can be identified readily.

Each individual and group among the aborigines has its sacred totems, which were created by the ancestors in the Dreamtime and then passed on through the generations. The totem, which may be a living creature, a natural feature, or a special object, has power through its totemic spirit, which is invoked in ceremonies to act as guardian and protector, to increase the food supply, to promote fertility, and for magic. Since they are sacred, the totems are kept secret, and their meanings are progressively revealed during ritual ceremonies.

Each man must learn the complex and secret meanings of the totems and myths as he passes through the age-grading rites, together with the rules and taboos which relate to daily living. In the process, he acquires the accumulated knowledge of the old men of the tribe, which he, in turn, will pass on. To some degree, the paintings and carvings thus become history books, serving to remind the people of the great events of the past, and to explain birth and death, the changing seasons, and the rules of conduct.

The aborigines remained unmolested for several thousand years. The first visitors were the Bajini, a prehistoric people. Next came the Macassans, who sailed to Australia from the Indonesian islands to the north. They were followed by a scattering of Europeans, then Japanese. Finally, European settlers came with an industrial civilization. Although the initiated aborigine prefers his own land and resists change, some have traveled to the Australian cities. Increasingly, today, the younger people are leaving the reserve, and abandoning the old ways.

Louis A. Allen is a well known collector of Australian aboriginal art. Joyce Zibro is editor of the Field Museum Bulletin.

CALENDAR

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Exhibits

Through January 9

Studies in Jade, a selection of books from Field Museum's library, featured in the South Lounge to coincide with the recent opening of the new Hall of Jades. Included are *The Bishop Collection, Investigations and Studies in Jade,* in two volumes, and *Chinese Jade Carvings of the XVIth to the XIXth Centuries in the Collection of Mrs. Georg Vetlesen,* in three volumes.

Opens January 11

Coco-de-mer, an exhibit of the world's largest seed and its use by man, on display in the South Lounge through March 5.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day. Continues indefinitely.

Hours

9 a.m. to 4 p.m. Monday through Thursday; 9 a.m. to 9 p.m. Friday; 9 a.m. to 5 p.m. Saturday and Sunday.

Closed New Year's Day.

The Museum Library is open 9 a.m. to 4 o.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Free Film Program

January 23

"20th Century Wilderness," wildlife film narrated by Tom Sterling, offered by the Illinois Audubon Society at 2:30 p.m. in the James Simpson Theatre.

Continues indefinitely

"Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturdays, and 11 a.m., 1 p.m., and 3 p.m. on Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

Children's Program

Through February 29

"Faces of Africa," Winter Journey for Children, a free, self-guided tour. Youngsters test their powers of observation by answering written questions and making sketches of four African masks in the Museum exhibit areas. All boys and girls who can read and write may join in the activity. Journey sheets are available at Museum entrances.

Meetings

January 9: 2 p.m., Chicago Shell Club

January 11: 7:45 p.m., Nature Camera Club of Chicago

January 11: 8 p.m., Chicagoland Glider Council

January 12: 7 p.m., Chicago Ornithological Society

January 12: 7:30 p.m., Windy City Grotto, National Speleological Society

January 13: 8 p.m., Chicago Mountaineering Club

Coming in February

Opens February 3

Australian Aboriginal Art from Arnhem Land, a selection of more than 400 bark paintings and some wooden ceremonial sculptures. The exhibit is unique because of the documentation accompanying most of the pieces, including when they were painted, their use, the region in which they were produced, and information about the artists. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27

Opens February 17

A New Spirit in Search of the Past: Archaeology and Ecology in Lower Illinois River Valley, an exhibit exploring the new dimensions of archaeology as reflected in the excavations at the Koster Site directed by Dr. Stuart Struever of Northwestern University. Through September 4. Hall 9.

Remember that a Field Museum membership is a special kind of gift for all occasions. For each gift membership we will send an announcement greeting card in your name and portfolio of four color reproductions of bird paintings done by the distinguished American artist Louis Agassiz Fuertes on a Field Museum expedition to East Africa.

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Candy vendor in Yuscarán, Honduras. Photo by Dr. Louis O. Williams, Department of Botany, Field Museum.

S	M	T	W	T	F	S
Field Museum hours: 9 am to 4 pm Mondays through Thursdays; 9 am to 9 pm Fridays; 9 am to 5 pm Saturdays and Sundays						1 NEW YEAR'S DAY Field Museum Closed Winter Journey for children continues at Field Museum
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january 1972

DECEMBER 1971

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FEBRUARY 1972

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Archaeology usually begins with digging, as here at the Koster Site, where eleven successive habitations dating from A.D. 1000 back to 5100 B.C. have already been uncovered. How these excavations reveal man's varying adaptation to a changing environment is the theme of a temporary exhibit opening this month at Field Museum, A New Spirit in Search of the Past: Archaeology and Ecology in Lower Illinois River Valley. Photo by George D. Olson.

S	M	T	W	T	F	S
		1 Winter Journey for children continues at Field Museum	2	3 Exhibit of Australian Aboriginal art opens at Field Museum	4	5
6 Exhibit of nature photography opens at Field Museum	7 LINCOLN'S BIRTHDAY OBSERVANCE	8	9	10	11	12
13	14 VALENTINE'S DAY	15 CHINESE NEW YEAR	16	17 Exhibit of "the new archaeology" in Illinois opens at Field Museum	18	19
20	21 WASHINGTON'S BIRTHDAY OBSERVANCE	22	23	24	25	26
27	28	29	Field Museum hours: 9 am to 4 pm Mondays through Thursdays; 9 am to 9 pm Fridays; 9 am to 5 pm Saturdays and Sundays			

JANUARY 1972

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MARCH 1972

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february 1972

Alligator Snapping Turtle, *Machrochelys temminckl*, in Field Museum's Color in Nature exhibit. Photo by Fred Huysmans.

march 1972

S	M	T	W	T	F	S
Field Museum hours: 9 am to 5 pm daily except 9 am to 9 pm Fridays			1 Exhibits of Illinois archaeology, Australian Aboriginal art continue; Spring Journey for children begins at Field Museum	2	3	4 Free film-lecture, Greece, 2:30 pm at Field Museum
5	6	7	8	9	10 Exhibit commemorating 50th birthday of Morton Arboretum opens at Field Museum	11 Free film-lecture, Cambodia, 2:30 pm at Field Museum
12	13	14	15	16	17	18 Free film-lecture, East Africa, 2:30 pm at Field Museum
19	20	21	22	23	24	25 Free film-lecture, Arctic Char, 2:30 pm at Field Museum
26	27	28	29	30 PASSOVER	31 GOOD FRIDAY	

FEBRUARY 1972

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APRIL 1972

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Bloodroot (*Sanguinaria canadensis*), found throughout eastern United States and Canada, blooms during April in Illinois. Photo by Dr. William C. Burger, Department of Botany, Field Museum.

S	M	T	W	T	F	S
Field Museum hours: 9 am to 5 pm daily except 9 am to 9 pm Fridays						**1** Exhibits of Illinois archaeology, Australian Aboriginal art, Morton Arboretum continue; Spring Journey for children continues; Free film-lecture, Southern Africa, 2:30 pm at Field Museum
2 EASTER	**3**	**4**	**5**	**6**	**7**	**8** Free film for children, Dinosaurs, 10:30 am; Free film-lecture, Amazon, 2:30 pm at Field Museum
9	**10**	**11**	**12**	**13**	**14**	**15** Free film for children, American Indians, 10:30 am; Free film-lecture, Outdoor Adventures, 2:30 pm at Field Museum
16	**17**	**18**	**19**	**20**	**21**	**22** Free film for children, Circus, 10:30 am; Free film-lecture, Baja California, 2:30 pm at Field Museum
23	**24**	**25**	**26**	**27**	**28**	**29** Museum Traveler Day; Free film for children, Darwin, 10:30 am; Free film-lecture, Wilderness, 2:30 pm at Field Museum
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april 1972

MARCH 1972

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MAY 1972

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Frank Boryca, of Field Museum's Department of Exhibition, shows Members' Night guests how plant models are made

may 1972

S	M	T	W	T	F	S
	1 Exhibits of Illinois archaeology, Australian Aboriginal art, Morton Arboretum continue; Spring Journey for children continues at Field Museum	2	3	4 Members' Night at Field Museum	5 Members' Night at Field Museum	6
7	8	9	10	11	12	13
14 MOTHER'S DAY	15	16	17	18	19	20
21 Field Museum permanent building opened in Grant Park 51 years ago, 1921	22	23	24	25	26	27
28	29 MEMORIAL DAY	30	31			

Field Museum hours: 9 am to 6 pm daily except 9 am to 9 pm Fridays

APRIL 1972

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JUNE 1972

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Bengal Tigers, *Felis tigris* Linnaeus, in one of Field Museum's famous natural habitat dioramas. The Museum pioneered in developing this exhibition technique.

june 1972

S	M	T	W	T	F	S
Field Museum hours: 9 am to 6 pm daily except 9 am to 9 pm Fridays				1 Exhibits of Illinois archaeology, Australian Aboriginal art continue; Summer Journey for children begins at Field Museum	2 Field Museum first opened in Jackson Park 78 years ago, 1894	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18 FATHER'S DAY	19	20	21	22	23	24
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MAY 1972

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JULY 1972

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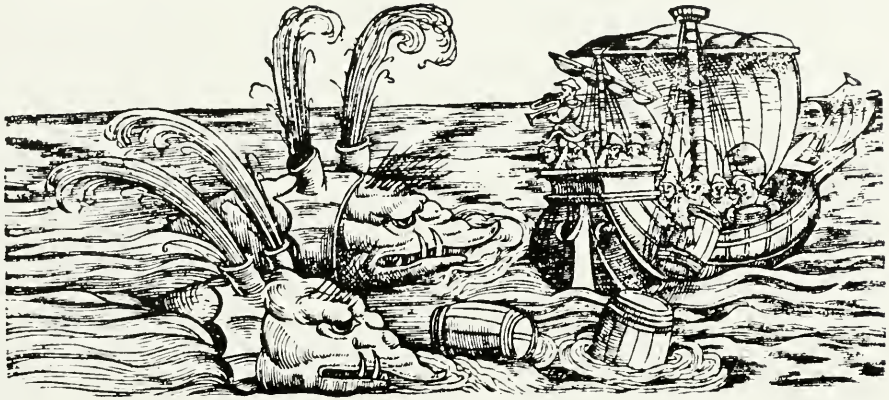
Allerley Wallfiſchen.



VTlich groſſe Balenen oder Braunfiſch / welche mit der gröſſe gleych ſöllend ſeyn dem gebirg/kerend die ſchiff ſo ſy bekommend zů grund/ſy werdind dann mit mächtigem geſchrey / getümmel / trummeten/vñ gethön von den lären faſſen in das Meer gewoꝛffen / abgeſchreckt vnd hinweg getriben/ welches auch in dem Balthiſchen Meer geſchehen ſol als hieuoꝛ gehört.

From Conrad Gesner's *Fischbuch* (German translation of volume 4 of his *Historia Animalium*), published in Zurich in 1575, a copy of which is in the rare book collection of Field Museum's Library: "All Kinds of Whales. Some great baleens or brownfish are said to be the height of mountains. The ships turn when they reach the grounds and then with mighty cries and wrestling and trumpets' sounds throw empty barrels into the sea to frighten them off and drive them away, as has happened in the Baltic Sea according to reports received here."

S	M	T	W	T	F	S
Field Museum hours: 9 am to 6 pm Mondays, Tuesdays, Thursdays; 9 am to 9 pm Wednesdays, Fridays, Saturdays, Sundays						1 Exhibits of Illinois archaeology, Australian Aboriginal art continue; Summer Journey for children continues at Field Museum
2	3 Free guided tour and film 2 pm Mondays through Fridays at Field Museum	4 INDEPENDENCE DAY	5	6 Free movies for children, 10 am and 1 pm, at Field Museum	7	8
9	10	11	12	13 Free movies for children, 10 am and 1 pm, at Field Museum	14	15
16	17	18	19	20 Free movies for children, 10 am and 1 pm, at Field Museum	21	22
23	24	25	26	27 Free movies for children, 10 am and 1 pm, at Field Museum	28	29
30	31	july 1972				

JUNE 1972

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AUGUST 1972

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When our 75-million-year-old recumbent *Lambeosaurus lambei* was found in Alberta, Canada by a Field Museum expedition, it was so carefully dug up and jacketed in five plaster parcels for shipping that merely removing one side of each jacket and positioning them together recreated for us its appearance in situ. The cement floor of the exhibit hides plaster around the edges, but underneath the bones we see the original rock matrix.

august 1972

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1 — Exhibits of Illinois archaeology, Australian Aboriginal art continue; Summer Journey for children continues at Field Museum

7 — Free guided tour and film 2 pm Mondays through Fridays at Field Museum

Field Museum hours: 9 am to 6 pm Mondays, Tuesdays, Thursdays; 9 am to 9 pm Wednesdays, Fridays, Saturdays, Sundays

JULY 1972

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SEPTEMBER 1972

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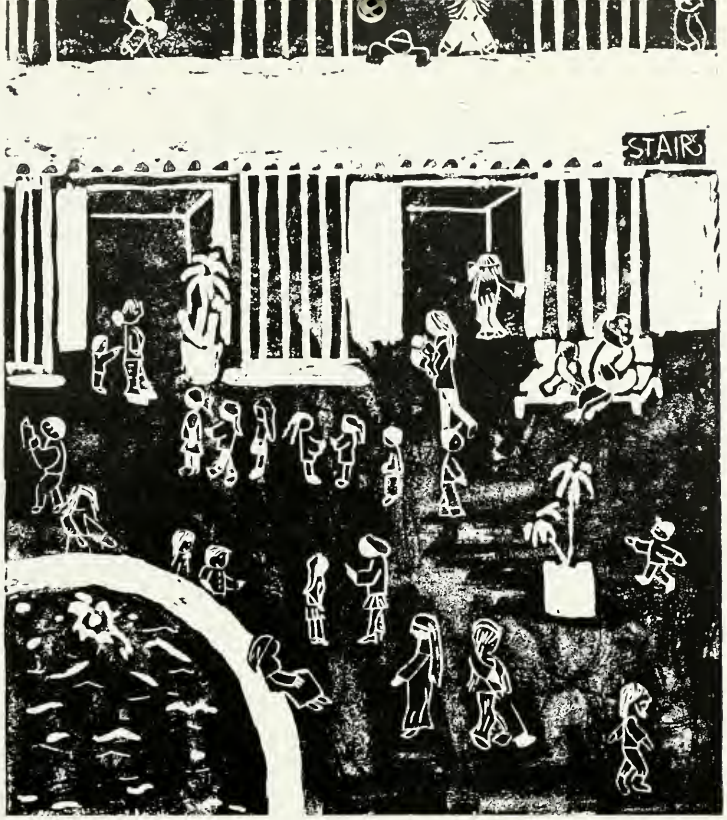

Dear Sir,

I like the Museum very much, and decided to make this picture for my 4-H county fair exhibit. I won a blue ribbon and Grand Champion - arts and Crafts. I am so pleased I wanted to share it with you!

(This isn't one of my good copies.)

Andrea Lee 11 years

S	M	T	W	T	F	S
Field Museum hours: 9 am to 5 pm daily except 9 am to 9 pm Fridays and September 2 and 3, 9 am to 6 pm September 4					1 Make application before September 15 for October Children's Workshops; Fall Journey for children begins at Field Museum	2
3	4 LABOR DAY	5	6	7	8	9 ROSH HASHANAH Exhibit of North American shorebird paintings opens at Field Museum
10	11	12	13	14	15	16 Charter for Columbian Museum of Chicago, first name of Field Museum, obtained 79 years ago, 1893
17	18 YOM KIPPUR	19	20	21	22	23
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september 1972

AUGUST 1972

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OCTOBER 1972

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Bicuspid teeth on the tongue of an Afghanistan land snail, magnified 2,920 times and first revealed by the scanning electron microscope. Many other such wondrous details of the living world can be seen in Field Museum's temporary exhibit Below Man's Vision opening this month. Photo by Dr. Alan Solem, Department of Zoology, Field Museum.

october 1972

S	M	T	W	T	F	S
1 Exhibit of North American shorebird paintings continues; Fall Journey for children continues at Field Museum	2	3	4	5	6	7 Exhibit of scanning electron microscopy opens; Free film-lecture, Britain's Holiday Islands, 2:30 pm at Field Museum
8	9 COLUMBUS DAY OBSERVANCE	10	11	12	13	14 Free film-lecture, Sea in Future, 2:30 pm at Field Museum
15	16	17	18	19 Training course for volunteers in education begins at Field Museum, 10 am to 3 pm Thursdays until February 22, 1973	20	21 Free film-lecture, Belgium and Luxemburg, 2:30 pm at Field Museum
22	23 VETERANS' DAY OBSERVANCE	24	25	26 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	27	28 Free film-lecture, Korea, 2:30 pm at Field Museum
29	30	31 HALLOWE'EN	Field Museum hours: 9 am to 5 pm daily except 9 am to 9 pm Fridays			

SEPTEMBER 1972

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NOVEMBER 1972

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Woodcut depiction "Of the thunderstone fallen in 1492 near Ensisheim" in Alsace, November 16. A piece of this meteorite is in Field Museum.

november 1972

S	M	T	W	T	F	S
Field Museum hours: 9 am to 4 pm Mondays through Thursdays; 9 am to 9 pm Fridays; 9 am to 5 pm Saturdays and Sundays			1 Exhibit of scanning electron microscopy continues; Fall Journey for children continues at Field Museum	2 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	3	4 Free film-lecture, Japan, 2:30 pm at Field Museum
5	6	7 ELECTION DAY	8	9 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	10	11 Free film-lecture, Hawaii, 2:30 pm at Field Museum
12	13	14	15	16 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	17	18 Free film-lecture, Inca Empire, 2:30 pm at Field Museum
19	20	21	22	23 THANKSGIVING DAY	24	25 Free film-lecture, Insects, 2:30 pm at Field Museum
26	27	28	29	30 Training course for volunteers in education, 10 am to 3 pm, at Field Museum		

OCTOBER 1972

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DECEMBER 1972

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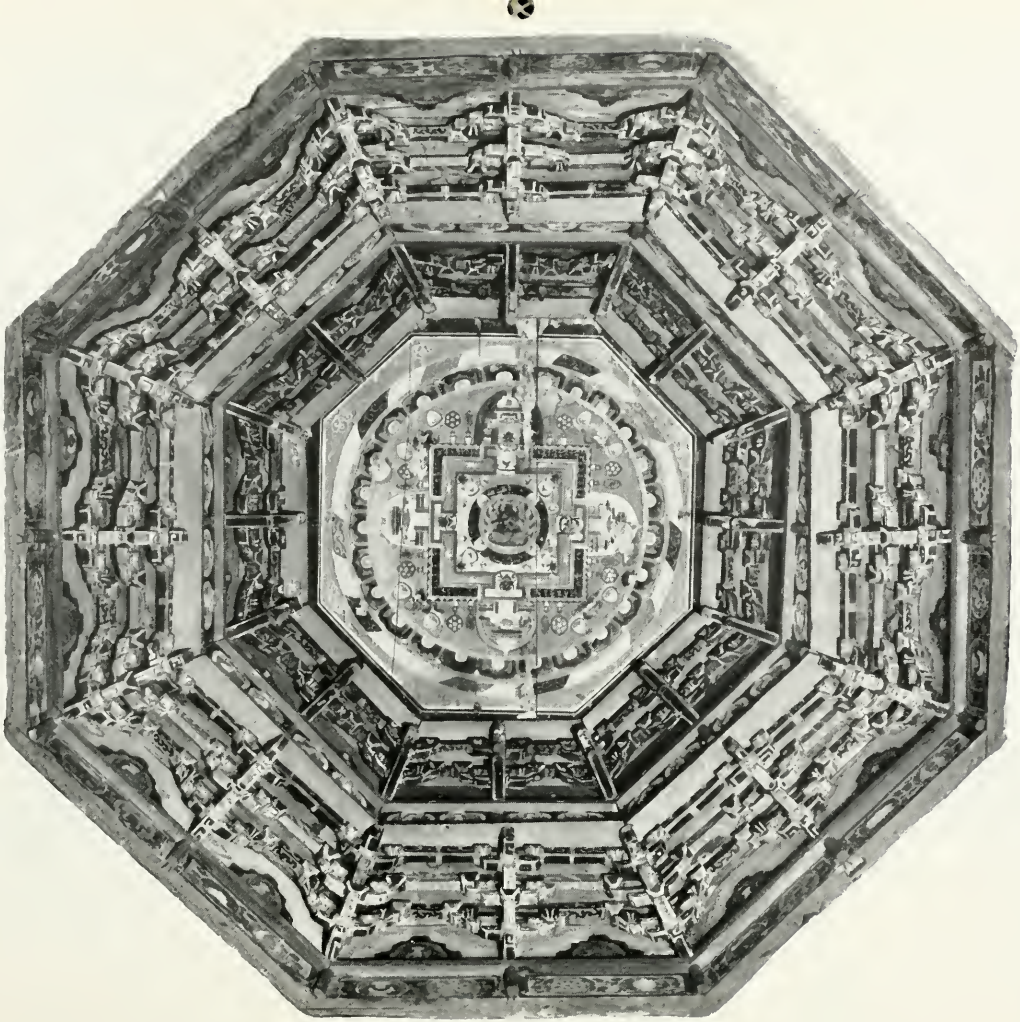

Painted wooden dome from a Lamaist temple. K'ang-hi period (1662-1722), Taochow, Kansu Province, China. This dome is now in the ceiling of the theater of the Tibet Hall, Field Museum.

december 1972

S	M	T	W	T	F	S
Field Museum hours: 9 am to 4 pm Mondays through Thursdays; 9 am to 9 pm Fridays; 9 am to 5 pm Saturdays and Sundays					1 FIRST DAY OF HANUKKAH Exhibit of scanning electron microscopy continues; Self-guided tour, Winter Greens, begins; Winter Journey for children begins at Field Museum	2 Field Museum bookshop has unusual gifts, at a discount to Members
3	4	5	6	7 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	8	9
10	11	12	13	14 Training course for volunteers in education, 10 am to 3 pm, at Field Museum	15	16
17	18	19	20	21	22	23
24	25 CHRISTMAS DAY Field Museum Closed	26 Free film and guided tour 1:15 pm through December 29 at Field Museum	27	28	29	30
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NOVEMBER 1972

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JANUARY 1973

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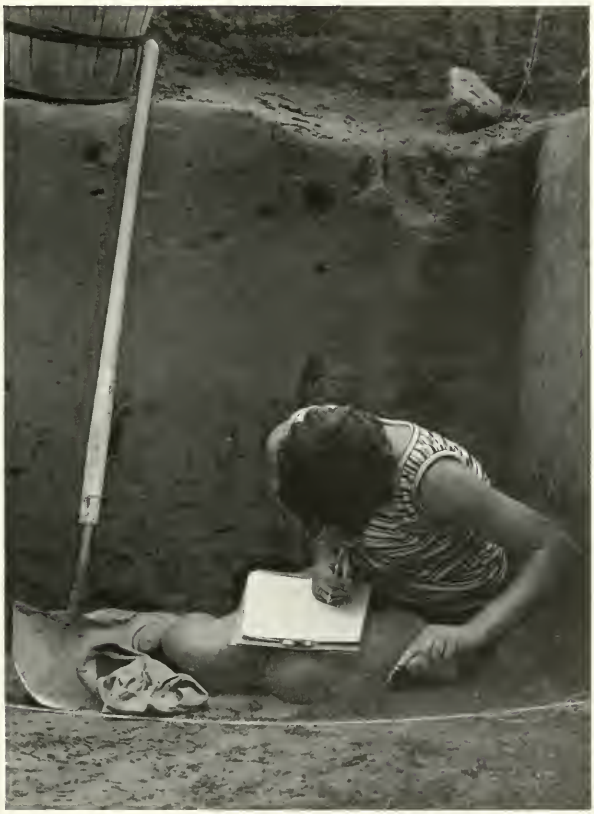
Volume 43, Number 2 February 1972

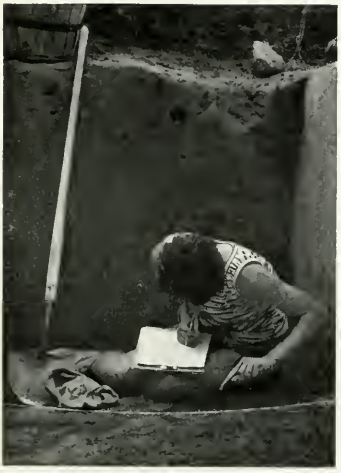
Field Museum
of Natural History

BULLETIN



Field Museum of Natural History Bulletin

Volume 43, Number 2
February 1972



Cover: A student carefully records an artifact before it is removed from an excavation at the Koster Site. Photo by George D. Olson.

2 **A New Spirit in Search of the Past**
Stuart Struever and Barbara Baum Collins
excavations at the Koster Site demonstrate in action the revolutionary change in archeology

8 **The English Flies**
W. Peyton Fawcett
Hiawatha sang of the coming conqueror: "Wheresoe'er they move, before them/Swarms the stinging fly, the Ahmo,/Swarms the bee, the honey-maker;"/

10 **The Ginseng Mystique**
Patricia M. Williams
why would anyone pay $50 for thirty dried-up roots?

13 **Book Reviews**

16 **Field Briefs**

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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A New Spirit in Search of the Past

Stuart Struever and Barbara Baum Collins

That a revolution is going on in the field of archeology no longer comes as a surprise to the academic world, nor to interested laymen who have read such excellent discussions as that of Paul S. Martin in the March 1971 *Field Museum Bulletin*. A scientific revolution is not simply the addition of new techniques or more rigorous analysis; it is an intellectual metamorphosis which shatters the traditions of a discipline and transforms the scientist's perception of reality.

What is this new spirit that pervades our search of the past? Briefly, the "new" archeologist is no longer interested in simply reconstructing culture history. Within the traditional framework, archeologists as culture historians have treated culture as the body of shared ideas of a group. They were concerned with setting up chronologies of given cultures, organizing lists of traits based on the study of artifacts, and reconstructing the origin and spread of the cultures as represented by the diffusion of "typical" artifacts. A tool or trait was regarded as the end product of a given group's ideas about what a tool should look like, and the archeologist attempted to reconstruct the "shared idea" that served as a model for the maker of the tool. Cultures were seen to change as tool types changed. The traditional or normative archeologist looked for the "typical" artifact, feature, and even settlement form of an extinct culture and identified the culture from them.

How does the new archeology differ? The new, or scientific, archeologist seeks to explain the processes of culture change. To do this, he looks at culture as a system made up of interacting parts. And more broadly, he looks at culture and its environments as representing a number of articulated systems in which change occurs through a series of minor, linked variations in one or more of these systems. Archeology, then, attempts to understand the linkages as reflected in the archeological data. The strategy is to isolate each system and study it as a separate variable, with the ultimate goal the reconstruction of the entire pattern of articulation. The hope is that regular, repeated relationships between certain variables will be found, and that testable hypotheses which explain the relationships can then be formulated.

Most importantly, this view assumes that material remains have a systematic relationship to the total culture, and that study of the total available material remains in relation to their spatial context will lead to understanding of the social systems behind them. Thus, there is no such thing as a "typical" artifact, for everything left by a prehistoric group has functional significance in the system.

As Dr. Martin stated, the ultimate goals in anthropology and archeology are to formulate laws of cultural dynamics—causes and effects; to seek trends and causes of human behavior; and to make probabilistic predictions.

The historical approach simply *describes* mechanisms of cultural process; the scientific archeologist seeks to *explain* them. It has been said that there is no such thing as historical explanation, only the explanation of historical events. In other words, as Lewis Binford has pointed out, historical explanations add nothing to the explanations of the processes of cultural change and evolution. If migrations can be shown to have taken place, then we have an explanatory problem: What adaptive circumstances or evolutionary processes induced the migration?

This calls for the use of the scientific method, and the new archeology is explicitly scientific archeology. The essential steps of the scientific method are to formulate hypotheses and then test them. Change to this methodology is the fundamental hallmark of the new archeology, which is still in its infancy. No longer does an archeologist choose a site to dig just because, like Mt. Everest to the mountaineer, it's there. His choices of region, of site, and of methods are determined by the hypothesis he wishes to test—and the hypothesis is problem-oriented.

Traditionally, data in archeology have been collected in the hope that the facts would speak for themselves. Philosophers of science argue, however, that if explanation is to be a product of research, it must also be an organizing principle. Explanations or laws are not summaries of facts. They are the result of the researcher's conscious, creative attempts to perceive patterns in the facts.

A serious explanation is thus a nomological, a covering-law, explanation which relates the circumstances to be explained to relevant general laws. The recitation of a list of successive events is not an explanation unless there are implicit laws or empirical generalizations linking the events. Science, and scientific archeology, seek causal or probabilistic statements. The logical structure of scientific explanation is identical with that of scientific prediction.

Thus, an adequate explanation of a particular case should be such that it can predict both "backward" and "forward." We have an explanation for an event only if the explanation could have predicted the event. In archeology, therefore, we seek explanations that can make predictions about yet-to-be-discovered facts of the past. But the explanations should be even more powerful. Though the major goal of archeology is to explain the past, these explanations should also help to explain contemporary events and to predict future events. Herein lies the excitement and the challenge of archeology.

North wall of main excavation at the Koster Site in 1971. The dark, organically-stained prehistoric village strata are clearly visible in the wall. The deepest stratum, near the base of the wall, has been dated by carbon-14 at 4200 B.C. Photo by D. R. Baston.

New Goals, New Strategies

With the recognition of culture as a system in articulation with other systems, both ecological and human, the scope of archeology has expanded dramatically. Exhaustive reconstruction of man-land relationships—prehistoric human ecology—are sought, and this requires massive multi-disciplinary field programs involving scientists of many disciplines and sophisticated equipment and techniques.

While in the past 10 years archeology in America has gone through an important metamorphosis in problem-definition and methods, there has not been a concomitant change in its institutional base. The exhibit in Field Museum's Hall 9, "A New Spirit in Search of the Past," presents an archeological program in southern Illinois that is approaching some of these new problems by means of new methods and, perhaps most important of all, attempting to achieve these ends through a new form of institution—the archeological institute.

The major problem faced by archeology today is the gap between its capacity to state new and important problems and its capacity to actually perform the research to solve these new problems. The main reason for this widening gap between ideas and performance is that universities and museums, the traditional "archeology-performing" institutions, are multi-purpose organizations with diverse responsibilities that restrict their ability to assemble the funds, facilities, and expertise necessary to conduct long-term inter-disciplinary archeological research.

Thus, the development of a new form of institution—the institute—is a major requirement of the new archeology. Unlike the university or museum, the institute would be capable of developing the methodologies, of assembling the requisite bodies of expertise, and of marshalling sufficient capital resources to undertake the complex research programs that are the outgrowth of our new questions. These programs would

Photo by Lewis W. Jarrett.

involve integration of specialists in the physical, biological, and social sciences who, with the aid of substantial labor and technical resources, would be capable of attacking questions of culture history and process that are effectively beyond the reach of the one-man-scholar, university- or museum-based archeology.

The Foundation for Illinois Archeology is the modest but real beginning of such an institution. Unlike universities and museums, it does not conduct archeology as just one of several major activities. The sole, central purpose of FIA is development of large-scale archeological programs like that exemplified by the Koster project in southern Illinois.

Research by the Foundation for Illinois Archeology has established that the largest concentrations of prehistoric populations were located in the major river valleys of the Midwest, and that the center of this occupation was located in the area surrounding the confluence of the Mississippi, Illinois, and Missouri Rivers. Excavation efforts, concentrated on the Lower Illinois River Valley, have included the study of five prehistoric towns and two cemeteries. The findings thus far are published in four technical books, with two more volumes currently in press.

In addition to its overriding goal of developing more effective organization of research to achieve detailed reconstructions of extinct cultures and their environments, the Illinois Valley Archeological Program has four specific aims.

1. To provide students with clinical training in archeological excavation and analytical methods coupled with laboratory experience in the specialized interfaces between archeology and the natural sciences, including geology, zoology, and botany.

2. To formulate and test hypotheses that explain the specific episodes of prehistoric culture change beginning to emerge from the archeological record.

3. To develop and refine new archeological methods in the "field laboratory."

4. To excavate the remains of prehistoric cultures that once flourished in this area, and to reconstruct their lifeways before urban expansion destroys the evidence.

The initial focus of the Illinois Valley Archeological Program has been to delineate the economic activities, settlement patterns, and population changes characteristic of a series of "Woodland" cultures spanning the period from 500 B.C. to A.D. 1200. Discovery of the Koster site in 1969 enables us to extend this picture back to at least 6000 B.C.

Two major excavation seasons (1970 and 1971) at Koster have revealed the ruins (horizons) of 14 prehistoric Indian villages, one superimposed over the other in layer-cake fashion, in 34 feet of soil. Horizon 13, located at a depth of 29 feet below present ground surface, has been recently carbon-14 dated at 5100 B.C. The 1971 Koster excavations terminated last August with detailed exploration of the first 10 prehistoric village ruins. Test probes reveal four additional ruins that lie at still greater depths. In a microcosm we have here a record of at least 8,000 years of pre-European history in a three-acre corn field in southern Illinois.

Archeologically, Koster is one of the most important sites to be discovered in North America in the past quarter-century. No other site has greater potentiality for revealing a record of human existence before European intrusion. Preservation of artifacts and food remains at the site are unusually good. Furthermore, since each prehistoric occupation level was followed by a period during which the small valley of the Koster Site was unoccupied, a layer of sterile soil accumulated overtop the village ruin. This soil layer served to protect the underlying cultural stratum against intrusion from later communities occupying this same small valley. This distinct separation of a long series of prehistoric village ruins is exceedingly rare in North American archeology.

The various special studies currently being conducted on the materials excavated at Koster include the following:

1. Stone, bone, shell, and ivory artifacts, which help the archeologists to delineate the cultural inventory of each of the communities represented.

2. Seeds and other plant remains, animal bones, shells, and even fish scales, studied by botanists and zoologists to help establish the prehistoric dietary and subsistence patterns, the seasons the site was occupied, as well as supplying essential information for reconstructing climatic successions during the 7,000 years of occupation.

3. Human remains, which are analyzed by osteologists to document small-scale evolutionary differences between prehistoric groups. They also indicate pathologies and burial practices, which are clues to prehistoric behavior.

4. Pollen remains, which enable palynologists to reconstruct the ecological environment and climate changes through time.

5. Snail shells, studied by a malacologist as extremely sensitive environmental indicators.

6. Burned wood and other carbonized remains, which, when radiocarbon-dated, can be used to assign dates to the various occupation levels where they are found.

7. House floors, storage pits, hearths, mud daub from house walls, cooking stones, chipping debris, and other "features" which are studied in spatial context.

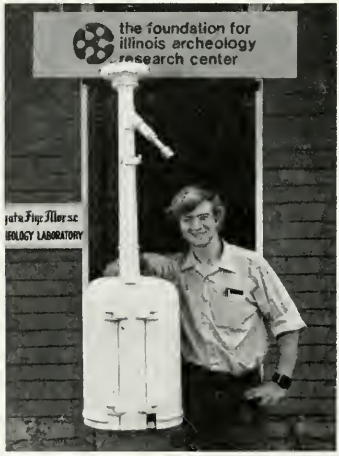
The Student Experience

Last summer we assembled a group of seven professors, 25 trained student field and laboratory assistants, and about 50 high school and college students from all over the United States to live for ninety days in Kampsville. We operated six research laboratories in abandoned store buildings while simultaneously excavating the Koster Site.

This program combines training in excavation technique with laboratory experience in a number of natural science disciplines. Students excavate a body of prehistoric data and follow it through a diverse series of operations. These range from conventional artifact analysis through study of the plant and animal remains reflective of prehistoric subsistence, through work with snails and soils that disclose the environmental setting to which early Indian cultures adapted. Each student not only receives instruction in excavation methods and artifact analysis, but works with geologists, zoologists, botanists, and others to learn what each can contribute to the total reconstruction of prehistoric systems. Installation of a computer terminal under the direction of James Brown of Northwestern University will be the major specialty added to the 1972 expanded program being planned.

Looked at from another perspective, we believe that our archeological field school serves a broad educational function—a function that makes it more valuable than simply a trade school for training future archeologists.

This is perhaps serendipity, the result of having to integrate a large group of scientists and students into a kind of academic commune which cloisters itself in a small, downstate Illinois village for three months while it digs and analyzes the contents of the 14 extinct Indian communities. Students not only see life from a different perspective as they interact with the people of Kampsville, but their isolation and single-purpose generate



Photos by George D. Olson.

an unusual intensity of experience that is almost absent from modern life.

Over the 15 years we have conducted these summer archeological expeditions, many examples come to mind of students who, over the duration of the project, have gone through a sort of metamorphosis. This is an archeological research project, the students are the labor crew, and they have the potential to make it a productive, well-executed excavation, or a sloppy affair that produces bad data. There are almost no external distractions, and the staff of professors and trained student assistants sets the tone. Their single-mindedness and research skill draw the uninitiated into the program, to identify with these leaders and the program's goals. It is almost axiomatic that a student will emerge in September different than when he joined the expedition in early June.

Important Discoveries of the 1971 Expedition

During the 1971 season we discovered the skeleton of an 18-month-old human infant, covered with red paint and buried with great care at a level dated to 7,000 years ago. Nearby, and at the same level, the Koster excavators unearthed the skeleton of a domesticated dog, carbon-14 dated to 5100 B.C. This represents one of the two earliest skeletons of domestic dog found thus far in North America, and opens a number of questions about the lifeways of the people of the period. Since animal domestication is usually associated with a sedentary way of life, the discovery of the dog in one of the earliest Koster villages raises the possibility that man in the Lower Illinois Valley had established stable, permanent communities by 5000 B.C.—and 6,000 years before he adopted agriculture as the primary means of subsistence.

One of the major purposes of the Illinois Valley Archeological Program over the past 13 years has been to understand the history of man's relationship to agriculture. Evidence from the Koster Site, and from other sites excavated by us, suggests that people may have developed a simple but effective "mud flat horticulture" in areas of the floodplain that are seasonally inundated. Large numbers of seeds of what are today garden-variety weeds—pigweed, lamb's-quarter, smartweed, and sunflower—have been recovered. Cultivation in the Illinois Valley had certainly begun by 800 B.C., and possibly much earlier, but field-cropping agriculture did not appear until A.D. 800. The fact that agricultural methods were known early, but that agriculture did not replace hunting and gathering as the basic means of subsistence for almost two millennia, raises interesting questions which we are investigating.

Excavations Resume at Koster in June

Our goal for the 1972 field season at Koster is to extend the main excavation into the four deepest and earliest horizons that underlie the villages already excavated. But the engineering problems created by deep excavation are formidable. The long, free-standing walls of the excavation must be braced. Now that we have reached the 16-foot level it is no longer possible to shovel our back-dirt out of the excavation by hand; a belt conveyor system will be necessary to transport the dirt out of our main trench. Finally, the deepest horizons lie beneath the water table and are inaccessible until a pump and drainage system are devised that will lower the water level. Together, these have increased substantially our 1972 budget.

We would like to invite you to share with us first-hand the excitement of discovery as this expedition progresses. Student groups, organizations, and families are invited to participate in guided tours of the Koster Site and the Kampsville Archeological Museum. Tours will be conducted from June 15 through the Labor Day weekend, and may be arranged by contacting the writers at Northwestern University. The Koster Site is located 45 miles north of St. Louis on the Illinois River near the village of Kampsville: the site is about a six-hour drive from Chicago. A visit to Field Museum's exhibit of the work being done at Koster would be good preparation for the trip.

Touring the site, you too may feel that the modern farm and the nearby remains of an early settler's stone house seem to form a link with those ancient settlers. One senses why man has always gravitated to this spot—the protective bluffs, the pure spring, the rich loess soil, and the resources of forest, field, floodplain, and the river. It is to understand this environment, and how a succession of prehistoric human communities coped with it, that is the goal of the Koster expedition.

Editor's note: Koster is one of the few grass-roots-supported archeological projects in the country. More than 600 individuals, corporations, and foundations were responsible for the success of the 1971 excavation season. While some of the 1972 expedition expenses will be defrayed by the federal government and Northwestern University, the increased burden of support will again fall to the private community.

Dr. Stuart Struever is Director of the Foundation for Illinois Archeology and Associate Professor of Anthropology at Northwestern University. Barbara Baum Collins is Editor of Foundation for Illinois Archeology Publications.

The English Flies

W. Peyton Fawcett

The honeybee *(Apis mellifera)* is an immigrant to North America, coming over with the earliest settlers. The date of its arrival is unknown; but, like a good many other colonists, it quickly settled down and prospered. The Swedish naturalist Peter Kalm noted in his *Travels in North America* that:

> Several English and Swedish farmers kept beehives, which afforded their possessors profit; for bees succeed very well here . . . The people unanimously asserted that the common bees were not in North America before the arrival of the Europeans, but that they were first brought over by the English who settled here. The Indians also generally declare that their fathers had never seen any bees, either in the woods or anywhere else, before the Europeans had been here for a number of years. This is further confirmed by the name which the Indians give them: for having no particular name for them in their language they call them English flies . . . They have not yet been found in the woods on the other side of the Blue Mountains, which confirms the opinion of their being brought to America recently.

It is known that bees were in Virginia by 1622 and that honey and beeswax were abundant by 1648. In 1641 bee colonies were being sold in New England for 5 pounds, the equivalent at that time of 15 days' work by a skilled craftsman. The honeybee was introduced into Florida by the English in 1763 and a little later a single colony was taken to Mobile, Alabama, as indicated by William Bartram in his *Travels:*

> In the course of conversation with . . . [Dr. Grant], I remarked that during my travels since leaving the Creek nation, and when I was there, I had not seen any honey bees; he replied that there were few or none West of the isthmus of Florida, and but one hive in Mobile, which was lately brought there from Europe; the English supposing that there were none in the country, not finding any when they took possession of it after the Spanish and French: I had been assured by the traders that there were none in West Florida, which to me seemed extraordinary and almost incredible, since they are so numerous all along the Eastern continent from Nova-Scotia to East Florida, even in the wild forests, as to be thought, by the generality of the inhabitants, aborigines of this continent.

Photos courtesy of *American Bee Journal.*

By the end of the eighteenth century honeybees were fairly common throughout the eastern half of the United States. Thomas Nuttall noted in his *Travels into the Old Northwest* that in the vicinity of Detroit in 1810 "considerable quantities of wild honey are collected in the woods but the bee here is certainly of European origin."

The honeybee played an important part in the lives of the early settlers of America both as a producer of honey and wax and as a symbol of their rural society. They associated the industrious and social nature of the bee with their own and the busy hum of the beehive with their settled farms and flower gardens and active community life, an association still remembered in words like *quilting-bee, sewing-bee,* and *husking-bee.* To them the bee also represented the advance of their civilization along the frontier. Thomas Jefferson noted that "the bees have generally extended themselves into the country, a little in advance of the frontier," and Washington Irving hailed them in his *Tour on the Prairies* as "the heralds of civilization, steadily preceding it as it advances from the Atlantic borders."

It is said that the bees usually spread 100 miles in advance of the actual frontier. In this respect they were very much like some of our forefathers; for, despite their long domestication, honeybees still retained their wild instincts to such an extent that they usually preferred to take to the woods instead of proceeding to the comfortable hives provided for them.

The Indians' view was, not unnaturally, considerably different from that of the settlers. Honeybees, like gunpowder, horses, and smallpox, were after all importations; and the sudden appearance of these "English flies" portended the approach of the white man and his civilization—a form of

divination whose prophecies always came true. It is of the honeybee and the white clover, which was also introduced by the Europeans, that Hiawatha sings when describing the coming of the conqueror:

> Wheresoe'er they move, before them
> Swarms the stinging fly, the Ahmo,
> Swarms the bee, the honey-maker;
> Wheresoe'er they tread, beneath them
> Springs a flower unknown among us,
> Springs the White Man's Foot in blossom.

Finding a swarm of bees warned the Indian that his people would soon have to move westward again. Irving remarked on the countless swarms of bees that overspread the West in "but a moderate number of years" and reported that "the Indians consider [the bees] the harbingers of the white man, as the buffalo is of the red man, and say that in proportion as the bee advances, the Indian and the buffalo retire." The advance was all too rapid.

Although the date of the first arrival of the honeybee in the United States is doubtful, the date of its introduction into the Far West is better known. It did not find its way by degrees as the line of frontier settlements advanced across the continent, but was carried there with great painstaking.

It is said that attempts had been made early in the nineteenth century to import bees into California from Mexico but that none survived the overland trip. There are even tales of pioneers "herding" bees across the Great Plains. A. J. Gridley of Michigan is actually supposed to have done this in 1858 or 1860, starting overland with four hives placed in the rear end of a wagon. Every day he halted in the afternoon, released the bees to work the rest of the day, and at night reclosed the hives. Thus day by day he moved slowly along, herding the bees, until he arrived in California with all four hives in good condition.

Assuming that Mr. Gridley did get his bees safely to California he found that others had already preceded him. W. A. Buckley, of Newburgh, New York, is usually credited with bringing the first hive to California in 1852. He started out from New York by boat with three hives and landed at the Isthmus of Panama, losing one hive en route. During the arduous crossing of the Isthmus the tropical heat melted the wax in another hive. On the Pacific side he took ship for San Francisco and arrived with the third hive in good condition.

In March of 1853 Thomas Shelton landed twelve hives in San Francisco, but only one of these contained live bees. This hive was taken to San José, where it threw off three swarms the first season. The owner was killed shortly thereafter and, in settling his estate, two of the swarms were sold at auction for $105 and $110 respectively. Other importations were made from time to time, by way of the Isthmus, and, although great pains were taken, about one-half usually died in transit. By 1858 there were at least eleven men in the bee business in California, each with from ten to one hundred hives. From California the honeybee spread north to Oregon and Washington.

When the state of Utah was admitted to the Union in 1896, Deseret (the name of the honeybee in *The Book of Mormon)* was the name first proposed. Today the great seal of Utah has as its center a beehive surrounded by flowers and overhead the word "Industry." This emblem could as fittingly serve for the great seal of the United States; for the honeybee has had a significant, if small, place in the history of the settlement of our country. *"Je suis petite, mais mes piqures sont profondes"* is the motto of the Order of the Bee, which can be translated "I am small, but my stings are deep."

W. Peyton Fawcett is head librarian, Field Museum.

The ginseng mystique

Patricia M. Williams

Drawing of *Panax quinquefolius* from *American Medicinal Plants, An Illustrated and Descriptive Guide to the American Plants Used as Homoeopathic Remedies: Their History, Preparation, Chemistry, and Physiological Effects*, Illustrated by the author; New York, 1887, vol. 3-4. The author, Charles F. Millspaugh, M.D., was the first scientific curator as well as first curator of botany at Field Museum.

Ginseng root is bitter, gray, and wrinkled. A rather more endearing aspect of this root is the fact that its value sometimes exceeds the price of gold. But the standard going price the last few years for wild ginseng root has been $44 to $50 per pound, and for cultivated root, which is considered inferior to the best wild ginseng, $23 per pound. It takes about three pounds of green roots to dry out to a pound of roots ready for the market—that's generally twenty-nine to thirty medium-to-large roots.

Why would anyone pay $50 for thirty dried-up roots? Because these roots are said by believers to be "good for what ails you." The generic name of the ginseng plant, *Panax,* is derived from the Greek words translated as "panacea"—cure-all. The Chinese have held ginseng in esteem since "time immemorial," as the encyclopedias express it. Confucious spoke of its great healing powers over 2,000 years ago. In his *Chronological History of Plants,* Charles Pickering, quoting an early source, reported " 'from the dynasties of the Tsin . . . down to that of the Tang there was no physician who did not constantly make use of' jinseng." Pickering also told of an emperor who in 1709 ordered 10,000 Tartars to go in quest of ginseng. Although it seems a waste of the Tartars' much touted skills as warriors, they returned with 20,000 kayte, or Chinese pounds, of the root. The *Atherva Veda,* an ancient medical book of India, declares that ginseng causes an aroused man to exhale fire-like heat. According to Sir Edwin Arnold's *The Light of Asia,* ginseng is said to add a decade to a man's life.

To millions of Asians today, who may chew the root to ease tensions, as well as make tea and a spring tonic from it, ginseng means good luck, longevity, and a powerful love and/or sex aid.

Now American health food enthusiasts have "discovered" ginseng, and any health food store worth its sea salt is displaying ginseng in a variety of guises—whole, in honey, as capsules, as a tonic, or as a liqueur which, as reported in a national women's magazine, "produces the total organic high—especially if you starve yourself for three days." A firm in Detroit is offering a mixture of ginseng, Royal Jelly, and vitamin E, which, as stated in their brochure, is supposed to "provide a life of more endurance, strength and general well-being." Cosmetic companies are also in on the ginseng movement and are boosting ginseng eye cream.

Americans may hear that ginseng is able to absorb bodily poisons, make the skin glow, soothe the throat and stomach, calm one's nerves, lure lovers from afar, and serve as an aphrodisiac. Not surprisingly, it is this last quality that has given ginseng its most enduring appeal. Although there is no scientific data to support the contention that ginseng is an aphrodisiac, the belief is a strong and prevalent one in Asian countries, with believers wearing the root as a sexual amulet. The old doctrine of signatures, which states that there is a specific herb or remedy for every human complaint and that the shape, taste, smell, or color of the herb may indicate its specific value, has probably had something to do with the establishment of ginseng as a sex stimulant. In fact, James Trager in *The Foodbook* states that "the Chinese penchant for ginseng root has its foundations in its suggestive appearance—it looks like male genitalia."

The esteemed root also—and probably more often—grows in the crude shape of the human figure, and this undoubtedly has formed the basis for the belief that ginseng is good for the whole man and all his ailments. It is said that a Chinese emperor once paid $10,000 for a man-figure ginseng root. Carson Baldwin, Jr., in *American Forests* magazine, reports that "Chinese leaders today are said to willingly pay $200 to $500 for roots having a man-like shape and cured to a translucency by a process known only to the Chinese." Herbalist Gertrude B. Forster wrote, "If you look in the window of a Chinese apothecary shop in New York's Chinatown you will see the dessicated roots lying in state in silk-lined boxes as proof of their monetary value."

Although use of ancient herbal remedies still flourishes in the Orient after 5,000 years, and despite the fact that about 1,500 licensed herb doctors in Taiwan rely on ginseng as a staple in their prescriptions, medical researchers in the western world presently believe its value to be purely psychic. A quick survey of *Index Medicus* indicates, however, that research with ginseng is being actively pursued in science labs the world over. Its effect on tumors, corneal opacity, and bacilli and its use as a sedative are just a few of the areas of research being explored.

Some ginseng is consumed in America for therapeutic reasons without benefit of FDA or AMA blessing. Many mountain folk swear by it as the best spring tonic they've ever tried. Herb hunters sometimes drink ginseng tea and chew the dried root, claiming it to be good for the stomach and digestive tract. Others may carry the root to ward off evil spirits and bring good luck.

These same mountaineers find ginseng to be more than a good spring tonic. For years hunters, woodsmen, and mountain dwellers have been making a comfortable spare-time or off-season income from ginseng root. Baldwin states that ginseng hunting was once a part of every farmer's life in the mountain regions of the eastern United States, and it was not uncommon for entire farm families to take to the woods for a day or two of 'seng hunting or for a father and son to camp in the mountains for a week or more digging ginseng roots.

American ginseng, *Panax quinquefolius,* called "green gold" and "fortune plant" by herb hunters, grows in the woods as far north as Quebec and Manitoba and southward to Florida, Alabama, Louisiana, and Arkansas. It lives inconspicuously in the shade of hardwood forests. In fact, lacking a

From *Plantae Asiaticae Rariores: or, Descriptions and Figures of a Select Number of Unpublished East Indian Plants*, by Nathaniel Wallich, M. & P.H.D., in the Bengal Medical Service of the Honourable East India Company, and Superintendant of the Botanic Garden at Calcutta; London, 1831, vol. II, p. 81. A copy of this rare, old folio volume is in the library of Field Museum's Department of Botany.

While I was in Nipal in 1820 and 1821, I found on the top of Sheopore, one of the highest mountains which surround the great valley, near the remains of an old fortification, at an elevation of between 9,000 and 10,000 feet above the plains of Bengal, a plant which I had no difficulty in recognizing as a species of *Panax* nearly allied to the *Ginseng*, if not identical with it. There was a good number of individuals growing under the thick shade of Oaks and Rhododendrums, within an area of forty or fifty feet square; but the most diligent and frequently repeated search by myself and my assistants convinced me that the plant was fixed, as it were, to one circumscribed spot; nor were our subsequent endeavours to find it anywhere else in Nipal attended with success. The natives of the country to whom I showed it were totally unacquainted with it, and ignorant of its virtues, real or imaginary; they had not even a name for it to give me, although in ordinary cases they are so fertile and inventive, and so utterly to be mistrusted in matters connected with the nomenclature of the productions of their country. The Resident at the Court of Katmandoo, my worthy friend the Honourable E. Gardner, at my suggestion intimated to that Durbar, or Government, that the country possessed a plant which was held in the highest estimation among their Chinese neighbours, and which might perhaps prove the most acceptable gift that could be sent to the Emperor with the triennial embassy from the Rajah of Nipal. But the matter was not considered in the light of one deserving of any further inquiry; the Government being either unwilling to contribute so grand a panacea to a Court which they look upon with feelings both of awe and envy; or disinelined to ascribe to that Court so great a degree of folly as to pay the weight in gold for an insignificant root, possessing no earthly sensible qualities, and of which not even the name is known in its native country. A very advantageous consequence has resulted from this proud feeling; it is this,—that our little innocent plant continues up to this day in the undisputed and undisturbed possession of its secluded and small territory, on the top of the above-mentioned mountain.

spectacular appearance to match its history, the plant may be easily overlooked. Wild ginseng grows 8 to 20 inches tall, and each plant bears several palmate leaves with five leaflets which look somewhat like those of the trifoliolate strawberry leaves. Clusters of small greenish-yellow flowers bloom in June or July; bright red berries follow later in the summer.

If ginseng could be found in abundance, many now part-time herb hunters would certainly make a profitable full-time business of digging and selling the roots. But the almost constant search for it and the mass clearing of forests in the last fifty years have made the plant scarce. In some of the more heavily forested areas of the Appalachians and Ozarks, though, the plant has made a strong comeback.

The sale of ginseng has a long history in America. Export of wild ginseng root from this country to China by way of France or England began in the early 1700s. In 1773 the sloop "Hingham" sailed from Boston for China with 55 tons of it aboard. The first shipment of ginseng direct to China after the American Revolution is said to have been made by John Jacob Astor from New York in 1782—and to have sold for $3 per pound. When American ginseng was approved by its Oriental buyers the "green gold rush" began. In the years 1858-1896 a total of 13,738,415 pounds was exported, with a peak total of 622,761 pounds in 1862.

The plant was abundant in the woodlands even though both the Indians and early settlers in America had used ginseng. Once the boom was on, however, the woods were picked clean of ginseng in no time at all. New England woods were depleted first, and the hunters began a search for other ginseng territory. Ginseng hunters are thus credited with exploring new regions of the nation. Struggling pioneers supplemented their meager—and in some dismal instances of crop failure, non-existent—incomes with ginseng sales. Whole communities of settlers are said to have been saved from economic ruin by the proceeds of ginseng sales.

In the time-tested tradition of supply and demand, the market price for ginseng rose as it became more difficult to find. The next step, obviously, was to cultivate it. Abraham Whisman is believed to have planted the first ginseng garden in the 1870s in a place called Boones Path, Virginia. Soon hundreds of gardens were planted with thousands of ginseng seeds. Government agriculture bulletins on ginseng growing sold out. Stock companies were formed to grow large amounts of ginseng. There were ginseng associations, ginseng laws, and ginseng trade papers.

But ginseng is not a get-rich-quick crop. It requires a great deal of time, patience, and effort. It must be grown under natural conditions which duplicate those of the wild. Too much sun will kill it—as will too little sun. Much of the labor involved must be done by hand. Cultivated ginseng takes five to eight years of this intensive care to grow a root to market size.

In 1904, Alternaria, a leaf parasite, attacked American ginseng and ruined both the plants and hopes of many ginseng growers. Today only about 600 acres of ginseng are planted in the United States, with Wisconsin the principal producer. The boom is long over, the excitement past, but ginseng is still a going business in America. The United States exports about 100,000 pounds of dried roots to the Far East annually, which amounts to about $4,000,000 for American ginseng hunters. Almost all of these roots go to Hong Kong for further distribution in Southeast Asia and Malaysia.

Of course, ginseng is also grown in Asia. Asian ginseng, *Panax ginseng*, is native to Manchuria and Korea and is cultivated in Korea and Japan. In some markets Asian ginseng is considered preferable to American ginseng. The demand is great, however, for roots from either continent.

Here in America most of those who are aware of the ginseng plant at all respect it as a source of income. Naturalists admire the green leaves in their shaded hiding places. Few but growing numbers of Americans believe ginseng root is in some way good for them. Some believers—Oriental and American alike—point to the *mahuang*, a plant the Chinese used for thousands of years in the treatment of asthma. Western medical men discovered that the plant contained ephedrine and now use it in the treatment of asthma and related allergies. Ginseng users believe further research may produce similar results and the vindication of "their root" in the western world. But if it does not, they will certainly go on believing in the mystique of the twisted ginseng root.

Patricia M. Williams is managing editor of scientific publications at Field Museum.

Indian Power!

Raymond J. DeMallie

The occupation of the abandoned federal prison island of Alcatraz by a group of young American Indians in November 1969 and its subsequent reseizure by armed United States marshals in June 1971 brought the Indian power movement to public attention. Similar take-overs of abandoned government property, justified by a clause in the Sioux treaty of 1868, have occurred in other parts of the country as well, such as recent attempts by a group of homeless Indians to settle on government land in the Chicago area.

The Indian power leaders and their supporters have frequently been branded as merely militant fanatics. Yet their actions have powerful symbolic value. They are effectively educating the American public to the problems of Indians, America's poorest minority, and to the fact that Indians will no longer sit passively on their reservations waiting for benefits from a sympathetic President and Congress.

At the same time, public concern about pollution and the environmental crisis has stirred interest in Indians, who as the original owners of this continent lived for many centuries in harmonious balance with nature. Young Americans in particular are looking to Indian life-ways, philosophy, and religion as sources of inspiration for solving the important problems of our times.

In the wake of this interest a flurry of books has appeared, some written by Indians themselves. The six volumes discussed here, which all appeared during the last two years, are representative of the diversity and breadth of this growing literature.

Bury My Heart at Wounded Knee: An Indian History of the American West
By Dee Brown. New York: Holt, Rinehart & Winston, 1970. 487 pp. $10.95.

This well-written history of the Plains Indian wars from 1860 to 1890 is, in the author's words, an "oral history." By this he means that he has attempted to let the Indians speak for themselves. Whenever possible the narrative is told in the words of Indian participants, taken from government documents, reminiscences, and from a large and diversified body of other source material. Brown presents us with an unabashedly biased history, while reminding us that all history is written from a point of view.

The book chronicles the destruction of the entire way of life of the Plains Indians during the unbelievably short period of thirty years. It is a story of wars and broken treaties, of military forces sent against Indian tribes with orders to fight and subdue first, and treaty afterward. The white man's side of the story is heard, too. Brown quotes, for example, a military officer who told the Cheyennes in 1867: "The white man is coming out here so fast that nothing can stop him. Coming from the East, and coming from the West, like a prairie on fire in a high wind . . . the whites are a numerous people . . . They require room and cannot help it." Thus Indians were pushed out of the way when their lands were needed, and they were resettled onto lands considered unsuitable for whites. At the beginning of each chapter the author outlines significant cultural and scientific events of the year in the world at large, placing this story of cultural genocide in the context of world history and implicitly pointing up the parallel to Viet Nam today.

One of the major criticisms that might be leveled against Brown's work is that all of his Indian characters appear flat; they do not come across as real human beings. Brown does not seem to have good understanding of the cultures of the various tribes with which he is dealing. When he falls back on the empathic approach to search for motives and to understand how a situation might have appeared to an Indian participant, his logic is always that of a child not understanding the world around him. His Indians are as stereotypic as those of many a less sympathetic writer; he fails to expose the shrewdness and tact which many Indian leaders were able to exhibit in their relations with whites.

It might also be suggested that some consideration of the histories of other tribes that did not engage in wars with the United States would throw a different light on the government's relationship to her Indian wards. An analysis of the reservation system as it was originally constituted would reveal a philosophy of cultural genocide more subtle and perhaps more effective than military subjugation.

Brown demonstrates a very competent control of a large body of source material. His good judgment in selecting sources is obvious even in the choice of the forty-nine portraits of Indian leaders that illustrate the volume. But it should be kept in mind that nothing is really new in this book; there's nothing that has not been told many times before. Our relationship to the Indian populations of this country is a conspicuous stain on the national conscience, and one which we have generally repudiated by attempting to submerge it. Happily, the time seems to have come to admit and expose wrongs, and to question what can now be done. This is one of Dee Brown's goals in presenting a summary of what is, after all, only the last phase of an Indian war that began when the first colonists set foot on North America. He writes: "If the readers of this book should ever chance to see the poverty, the hopelessness, and the squalor of a modern Indian reservation, they may find it possible to truly understand the reasons why." As an introduction to the history of some of America's Indians, Brown's book is heartily recommended.

The Memoirs of Chief Red Fox
With an Introduction by Cash Asher. New York: McGraw-Hill Book Company, 1971. 208 pp. $6.95.

Red Fox is an Oglala Sioux Indian who in 1880 became one of the first of his tribe to be sent East to the Indian boarding school at Carlisle, Pennsylvania. After graduation Red Fox traveled extensively, first as a sailor and later as a member of various Wild West shows. During the Spanish-American War he enlisted in the Navy. His has been a long and remarkably varied life, but he has never

lived on an Indian reservation. He is now 101 years old. Editor Cash Asher based these memoirs on notes written by "the Chief" himself, supplemented by interviews with Red Fox.

Historically, there is little that is useful in this volume, although it makes entertaining reading. Red Fox's reminiscences are sparse, and do not fill in the details that we would like to know about his experiences at school, with the Wild West shows, and his later adventures in making silent films. Instead, about half the volume is taken up with an account of the Sioux wars with the United States. Red Fox writes from memory and hearsay; his narrative is historically inaccurate and in contrast with Dee Brown's book.

Perhaps the most intriguing aspect of this volume comes in attempting to understand the position of this man and the many others like him who were taken away from their families as small children during the late nineteenth and early twentieth centuries, placed in boarding schools, and educated to become white men. Many of these people are the notorious "Uncle Tomahawks" whose capitulation to the whims of government and some other whites is so disappointing to younger Indian militants. Yet we can see in Red Fox's story that he came to share in the value system of the dominant white society, that he felt and feels that the American Indian is a vanished race. Red Fox's life is the story of personal cultural defeat; his memoirs add another dimension to our understanding of Indians in America today.

The Death of the Great Spirit: An Elegy for the American Indian
By Earl Shorris. New York: Simon and Schuster, 1971. 253 pp. $6.95.

Earl Shorris is a journalist who traveled extensively throughout western America, visiting Indians both on their reservations and in cities. From a large collection of notes and interviews he has put together a volume which reflects vividly the diversity of contemporary Indian life. He has seen much, but the feeling comes across that he has not always understood what he has seen, despite some attempt to make sense of the American Indian by borrowing concepts from Rousseau, Lévi-Strauss, and Toynbee. But the merit of the book is the first-hand account of Indian individuals and groups, depicted in a lively journalistic style.

Shorris blames the poverty and demoralization of so many Indian tribes not only on the devastating wars waged by the European invaders but, perhaps more importantly, on the good-intentioned but incompetent white "Indian lovers" who since the days of the Indian wars have tried to hasten the incorporation of Indians into the American melting pot and so the mainstream of modern economic life. Their efforts have been fruitless because Indian cultures are based on different premises than Western civilization; they lack the internalized drive toward progress. Only now, Shorris suggests, are Western men coming to understand the validity of other cultural styles—but too late. The American Indian movement today, he writes, "is to save themselves from cultural extinction while trying to rise up out of brutalizing poverty." To the dismay of some whites, Indians want to retain their own cultures, and want to retain their own land base, their reservations. They do not want to be incorporated into the American dream. The tenor of Shorris' book is to assert that it is too late, that "the time of modern man" is "irreversible" and "cannot be recovered." Yet this seems to belie his own observations as he reports them, and suggests rather that the author himself is too intimately a part of Western culture to see the possibility of other ways of life.

Shorris' book is valuable for this very built-in paradox. The author himself does not seem to realize the implications of the material which he has reported—that the Indian in modern America is still alive and ready to come into his own.

We Talk, You Listen: New Tribes, New Turf
By Vine Deloria, Jr. New York: The Macmillan Company, 1970. 227 pp. $5.95.

Treading on the moccasin fringes of his successful first book, *Custer Died For Your Sins: An Indian Manifesto* (Macmillan, 1969), Vine Deloria has presented a wide-ranging commentary on American life. He covers the issues of minority groups, role of the churches, the environmental crisis, and the political scene in general. The Indian point of view turns out to be unique and insightful, for the author presents us with an optimistic picture of Indian affairs, which suggests that Indians may be far better off than the rest of the American population. Indians, by retaining their tribal governments and what is left of their land base, and by being organized in legally recognized groups, are more effectively able to deal with the United States government than are other minority groups. The most important point is that Indians today are still Indians; traditional styles of clothing and traditional ways of making a living are not the distinguishing marks of any people. Culture is what distinguishes a people as a group, and American Indians have clung tenaciously to their cultural outlook on the world.

Deloria suggests that it is time for the entire country to organize on the tribal model, with recognized group structures and individual group land bases, in order to combat the problems of modern Western life more effectively. Much of the country must be returned to the natural enviromental conditions, he suggests, if we are to survive. "The ultimate irony," he writes, "is that the white man must drop his dollar-chasing civilization and return to a simple, tribal, game-hunting, berry-picking life if he is to survive." Ideas of land use that have always been held by American Indians—that land is sacred, a mother, to be lived with, not off of —must be taken over by the Western world if we are to survive. He envisions a world in which city-dwelling people would be organized into community organizations

according to place of residence, and in which those dissatisfied with urban life would return in small groups or tribes to live in the wilderness areas.

It is a wonderful opportunity with which we are presented. the American Indian, whom we have thought to have silenced forever, has survived and now is talking back. Indians are one of the constituent groups—or rather, form some of the many constituent groups—of America; as such we must listen to them, ponder, and learn. A different cultural viewpoint adds a fresh perspective and new depth to our understanding of ourselves.

Of Utmost Good Faith
Edited by Vine Deloria, Jr. San Francisco: Straight Arrow Books, 1971. 262 pp. $10.

This is a volume of extracts from Indian claims cases, treaties, court decisions, and speeches by both whites and Indians, all concerned with the legal relations between American Indians and the government. Through this volume it is possible to follow the whole course of Indian affairs in the United States. It is intended both for Indians and whites concerned with the legal relations between the Indians and the federal government. In his brief Introduction Deloria notes that the United States has admitted its liability in such tragedies as the Sand Creek and Wounded Knee massacres, and in the unsettled status of many Indian claims, yet the government has refused compensation. "This is a wrong that needs to be corrected. Instead of taking over abandoned islands to which there is a tenuous claim, Indian militants could be proclaiming the admitted liability of the United States from every rooftop." He points to the fact that over 7,000 Indians are presently enrolled at colleges and universities, and that the prospects for Indians have never looked brighter. It is in manipulating the special legal relationships that Indian tribes have to the federal government that Deloria sees future gains by American Indians. But this advancement depends on careful historical and legal study of the vast documentation of Indian-white relations in this country. This volume performs the service of outlining some of the highlights of this literature, and suggesting, through editorial notes, the possible applications to the current scene.

Red Power: The American Indians' Fight for Freedom
Edited By Alvin M. Josephy, Jr. New York: American Heritage Press, 1971. 259 pp. $6.95.

Josephy has prepared a collection of extracts from major policy statements by both the federal government and Indian groups concerned with the Indians' struggle for self-determination. The book opens with a 1911 statement on "The Indian Reservation System" by Thomas L. Sloan, an Omaha Indian, and a 1949 plea for "Indian Self Government" by the well-known lawyer Felix Cohen, who spent much of his life working for the benefit of Indians. The rest of the book is taken up with documents written after 1960.

An extract is given from the historic 1961 American Indian Chicago Conference at which a large gathering of Indian leaders, young and old, enunciated their demands for recognition of the validity and dignity of their cultures and of their ability to manage their own affairs. Similar extracts are given from a 1964 Conference on Poverty and other important gatherings of Indians, including the manifesto of the Indians of All Tribes at Alcatraz in 1969. Documents are presented concerning the fish-ins in the State of Washington and the problems of Indian water rights.

The recent development of federal Indian policy is documented by Senator George McGovern's 1966 "Resolution for a New National Indian Policy"; Josephy's 1969 study of the Bureau of Indian Affairs made at the request of Richard Nixon when President-elect; the 1969 Indian Task Force report to Congress; and, finally, Nixon's historic 1970 "Message to Congress on Indian Affairs," which assured Indians that the present policy of the federal government is to reject the old policy of the Eisenhower administration to terminate federal assistance to Indians (including the whole reservation system) and to reject government paternalism in the management of Indian affairs—"Self-determination among the Indian people can and must be encouraged without the threat of eventual termination." The President emphasized the unique status of Indian Americans because of the government's legal responsibilities based on treaties and other agreements. He outlined plans for improving Indian education, economic development, and Indian health programs, and announced a continuing series of meetings under the direction of the National Council on Indian Opportunity, a group that includes eight Indian members and is formally headed by the Vice President. The hope is to implement a plan of wiser expenditures of monies for improving the conditions of Indian life by making Indians themselves responsible for the development and administration of their own affairs.

The volume concludes with an excellent essay by Vine Deloria, Jr. entitled "This Country was a Lot Better Off When the Indians Were Running It." It is a personal, autobiographical view of the Indian reservation system and federal Indian policy since the New Deal.

Josephy has made an excellent selection of significant materials, and has put each in context with good introductory notes as well as a brief general introduction. This book constitutes an easily read history of the maturation of the Indian power movement in the United States during the last decade. We can look forward anxiously and optimistically to accomplishments in the rest of the 1970s.

Dr. Raymond J. DeMallie is Visiting Postdoctoral Research Fellow, Department of Anthropology, Smithsonian Institution, Washington, D.C.

FIELD BRIEFS

Spring Geology Field Trip to Ozarks

Field Museum, in cooperation with the University of Chicago, will sponsor a geology field trip to the Ozarks of Missouri March 26-April 1, conducted by Dr. Matthew H. Nitecki, associate curator in Field Museum's Department of Geology.

The beautiful Ozark region is a diversified geological area that consists of igneous and sedimentary rocks. The oldest igneous rocks and granites are at least one billion years old. The sea covered the area many times and deposited predominantly limey sediments which later became sedimentary rocks. Other geologic processes produced deposits of mineable ores, particularly lead and iron. A wide variety of geological phenomena will be studied in the field, and fossils and minerals will be collected in the mines and quarries.

The trip will include four long hikes, for which hiking clothes are required. Headquarters will be in picturesque Ste. Genevieve, a two-century-old French river town, unique for its peacefulness and historic and architectural interest.

Tuition of $140 includes train transportation to St. Louis, chartered bus in the field, and all meals. Members of the Field Museum are entitled to a ten percent discount. Hotel reservations at $5 to $10 a day per person will be made for the group.

Anyone interested in joining the trip is invited to attend a preliminary meeting Saturday, March 4, 10 a.m., at the University of Chicago Downtown Center. For further information and application forms, call Mrs. Maria Matyas at FI 6-8300.

New Flora of Costa Rica

With the publication of "Flora Costaricensis" (*Fieldiana* Botany, Volume 35, Publication Number 1140) by Dr. William C. Burger, associate curator of vascular plants, the Museum initiates a new "Flora of Costa Rica."

This project continues Field Museum's interest in Costa Rica. It was here that famous Museum botanist Paul C. Standley wrote his "Flora of Costa Rica," the first complete listing of Costa Rica's flowering plants. Standley's work was essentially an annotated check-list; the new Flora will include full descriptions and keys covering the native, naturalized, and more conspicuous cultivated plants. The Flora is intended for a wide variety of users, but a working knowledge of botanical terminology is assumed.

Preparation for beginning this Flora has included intensive field work over the last eight years. This work was made possible, in large part, through grants from the National Science Foundation. The grants were prepared and supervised by Dr. Louis O. Williams, who enlisted the cooperation of the Museo Nacional of Costa Rica and the Escuela Agricola Panamericana of Honduras.

"Flora Costaricensis" may be ordered from the Museum's Publications Division. Price is $10. Members of the Museum are entitled to a ten percent discount.

Aboriginal Art Catalog

Australian Aboriginal Art from Arnhem Land, a comprehensive catalog of Field Museum's new exhibit of nearly 400 bark paintings and wood sculptures produced by the aboriginal people of Arnhem Land in northern Australia, is now available at the Museum's Book Shop. The catalog was written by Louis A. Allen and contains 92 black and white illustrations. Price is $2. Members of the Museum are entitled to a ten percent discount.

Promotions for Museum Personnel

Three people in the Museum's scientific departments were recently promoted. Dr. Glen Cole was named associate curator of prehistory in the Department of Anthropology. Dr. Patricio Ponce de Leon is now associate curator, cryptogamic herbarium, Department of Botany. Mr. Henry S. Dybas' new title is curator of insects, Department of Zoology.

Student Gives $10 to Capital Campaign

The Museum of Natural History
Capital Campaign to $25 million
South Lake Shore Drive
Chicago

Dear Sirs:

I read in the paper yesterday that a generous citizen donated one million dollars. I am a Chicagoan and take great pride in our city. If this man can give one million dollars to the benifit of the city he must love, then I, who feel a deep love for Chicago, can do at least as much. I am a student, and this is as much as I can afford at present. Please accept my gift.

Sincerely,
Lary Louis Gatlin

CALENDAR

Hours

9 a.m. to 4 p.m. Monday through Thursday; 9 a.m. to 9 p.m. Friday; 9 a.m. to 5 p.m. Saturday and Sunday; 9 a.m. to 5 p.m. Washington's birthday, February 21.

The Museum Library is open 9 a.m. to 4 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Exhibits

Opens February 3

Australian Aboriginal Art from Arnhem Land, a selection of nearly 400 bark paintings and some wooden ceremonial sculptures. The exhibit is unique because of the documentation accompanying most of the pieces, including when they were painted, their use, the region in which they were produced, and information about the artists. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

Opens February 6

27th Chicago International Exhibition of Nature Photography, featuring award-winning prints. Sponsored by the Nature Camera Club of Chicago and Field Museum. Through February 20. South Lounge.

Opens February 17

A New Spirit in Search of the Past: Archaeology and Ecology in Lower Illinois River Valley, an exhibit exploring the "new archaeology" as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Eleven successive habitations, dating from 5100 B.C. to A.D. 1000, are yielding information about man's adaptations to his changing environments through time. Through September 4. Hall 9.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day. Continues indefinitely.

Coco-de-mer, an exhibit of the world's largest seed and its use by man, on display in the South Lounge through March 5.

Free Film Program

February 6 and 13

Showing of prize-winning transparencies from the 27th Chicago International Exhibition of Nature Photography at 2:30 p.m. in the James Simpson Theatre.

February 13

"Okinawa—Mecca for Mollusks," slide lecture presentation narrated by Viola Perrault, offered by the Chicago Shell Club at 2 p.m. in the Lecture Hall.

February 27

"A Naturalist Afield," wildlife film narrated by Karl H. Maslowski, offered by the Illinois Audubon Society at 2:30 p.m. in the James Simpson Theatre.

Continues indefinitely

"Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturdays, and 11 a.m., 1 p.m. and 3 p.m. on Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

Children's Program

Through February 29

"Faces of Africa," Winter Journey for Children, a free, self-guided tour. Youngsters test their powers of observation by answering written questions and making

sketches of four African masks in the Museum exhibit areas. All boys and girls who can read and write may join in the activity. Journey sheets are available at Museum entrances.

Coming in March

Begins March 1

"Our Vanishing Wildlife," Spring Journey for Children, a free, self-guided tour focusing on animal species that face extinction, to help youngsters understand what is happening to them. All boys and girls who can read and write are welcome to participate in the activity. Journey sheets are available at Museum entrances. Through May 31.

Opens March 10

Morton Arboretum: 50th Anniversary, a commemorative exhibit. Through June 4. South Lounge.

Spring Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

March 4: **"Grecian Holiday,"** narrated by Ralph J. Franklin, looks at ancient ruins and modern cities.

March 11: **"Cambodia,"** narrated by Kenneth Armstrong, visits Angkor Wat, the capital of Phnom Penh, cities and villages.

March 18: **"Trails of Tembo,"** narrated by Larry Linnard, travels to East Africa, land of the "big tusker," for wildlife scenes.

March 25: **"On the Trail of the Arctic Char,"** narrated by Karl H. Maslowski, searches for adventure in Canada's Far North.

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BULLETIN

Field Museum of Natural History Bulletin

Volume 43, Number 3
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Cover: Diagram of male goat "jousting" behavior to establish dominance; he rears erect and then crashes down upon his rival. Design by Zbigniew Jastrzebski.

2 **How to Tell the Sheep from the Goats**
Charles A. Reed and William M. Schaffer
from discovery of how to sort 8,500-year-old bones of animals that look notoriously alike comes new understanding of evolutionary interconnectedness of horn, bone, brain, and behavior

8 **International Nature Photography Exhibition**
William C. Burger
amateur photographers from around the world capture nature on film

12 **A Tale from the South Pacific**
John Terrill, assisted by Sampson Purupuru
as archeological prehistory reveals ever more about ancient life on the islands, legendary prehistory is fading from people's minds

19 **Book Reviews**

20 **Field Briefs**

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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How to Tell the Sheep from the Goats

Charles A. Reed and William M. Schaffer

The challenge—first stage in a joust between two male Nubian ibex (*Capra ibex nubian*) in the Sinai.

In scientific research, as the practicing scientist knows from personal experience, not everything leads straight forward to the expected goal. The research described here began with one set of problems, basically archeological, and got diverted in part to another kind of problem, involved with the correlated evolution of the behavior and anatomy of sheep and goats.

The beginning was in 1954, when the senior author (Reed) went out to the Near East to help Robert Braidwood, of the Oriental Institute at the University of Chicago, excavate Jarmo, a prehistoric village-site in the foothills of northern Iraq. The villagers of Jarmo, some 8,500 years ago, were growing wheat and barley and rearing sheep and goats, pigs and dogs. We recovered the broken, scattered bones of these domestic animals, and also those of several kinds of hunted species, such as wild pigs, gazelle, deer, cattle, onagers (Asiatic asses), and many smaller wild animals.

Reed's original problems were to identify species and to distinguish which individuals were domesticated and which wild. However, the archeologists also wanted to know in what relative numbers the different kinds were present 8,500 years ago, at what age the animals were killed, and if any changes in fauna occurred during the 500 years the village was continuously occupied.

Many of these questions could be answered by comparison of the bones from Jarmo with the skeletons in the excellent osteological collections at Field Museum. Sheep and goats presented a special problem because, being rather closely related animals, their skeletons are extremely similar. However, as Reed sorted out the broken pieces from groups of mixed bones of sheep and goats, he noticed differences in the posterior parts of the skulls. Some were shorter and straighter; others were more elongated and bent down. These differences became more meaningful when the pieces of ancient, broken skulls were compared with skulls of some modern sheep and goats which had been sawed open lengthwise.

The skulls of the goats were the ones which were short and straight in the rear, a structure correlated with long but relatively light horns. The skulls of sheep not only had their rears elongated and bent down, they also carried heavier horns. Such characters, in the language of the evolutionary biologist, are "more specialized."

As an evolutionary biologist, Reed wondered about the functional significances of these differences, and

how they were related particularly to the behavior of the two kinds of animals. Answers were not to be found in veterinary textbooks or in the books of hunters' tales, or even in the more technical wildlife literature of the period on sheep and goats.

Thus the matter rested until the spring of 1964, when Schaffer (the junior author, and then a freshman at Yale University) had an urge to try his hand at independent research. Reed, who was then mammalogist at Yale's Peabody Museum, suggested the problem of the sheep and the goats. Now, eight years later, we think we have some answers. It all took that long because we followed a few alleys toward blind ends, and of course each of us has done some other things too.

The common words "sheep" and "goats," as have been used here, make the situation sound much simpler than it really is. Actually involved is a definite group of animals, together called the Caprini, of which there are five different kinds (genera). Their names are: *Capra* (turs, ibexes, wild goats of several species, and the domestic goats); *Hemitragus*, (the tahrs, of which there are three species); *Ammotragus* (the Barbary "sheep," which is as much a goat as a sheep); *Pseudois* (the blue sheep); and *Ovis* (the several species of true sheep, including domestic sheep). All of these are Old World in distribution except the American bighorn, or Rocky Mountain sheep; it is a relatively late Ice Age immigrant from Asia into western North America.

Amongst the bovids (the general group of sheep, goats, antelopes, cattle, buffalos, musk-oxen, etc.), the Caprini are most closely related to the Rupicaprini, which group includes the chamois, a small mountain-living antelope-like animal of Europe and the Caucasus, and the Rocky Mountain "goat," which isn't a true goat but superficially looks like one. These two groups, the Caprini and Rupicaprini, are probably descended from a common ancestor—some antelope of several million years ago which had become more adapted for climbing and leaping in rocky hills than for swift running on the plains. Such agility, coupled with alert wariness, generally insured survival from such mountain-living predators as leopards, snow leopards, bears, and wolves. In other words, the rupicaprines and caprines have become so well adapted to a difficult terrain that what might seem to others to be a harsh environment is for them a favorable one.

The Caprini differ from their rupicaprine cousins in one fundamental pattern of behavior: sheep and goats are often seen banging their heads together. They butt. Rupicaprines, by contrast, either fight rarely or, if they do, they deliver blows of the head to the opponent's body.

Of the Caprini, the males mostly do the butting. But it is not an aimless, continuing activity. Serious fights—or better, "jousts"—occur only between strange males, adults or near-adults, who must settle the important matter of their social dominance. At least in sheep, whose behavior has been best studied, the winner of any such serious joust continues to act like a male, and the loser demonstrates his subordination by acting like a female.

The males with the larger horns are almost always the dominant rams. They not only intimidate or drive other males away from receptive females, but are seemingly preferred by such females, and hence sire a greater proportion of the next year's crop of lambs than do other rams. There is, thus, a natural selection for large horns amongst rams of *Ovis*. We believe that the same principle holds true for the males of the other Caprini.

However, the males of the different kinds of Caprini joust in quite different patterns, each style consistent for one kind; and each style of head-ramming or horn-clashing is related to the shape of horn and head of that kind of animal. If, for instance, two male goats (*Capra*), which merely clash their horns together from a standing position, were to try to act like the males of sheep (*Ovis*), which actually charge each other at the full run, the goats would kill themselves at the first contact. A ram's horns and head have evolved as a structural design which will absorb a much greater shock than does a goat's without addling his brain. This correlation between behavior, function, and structure is the crux of our story.

Wild male goats, for instance, have long thin horns curving like sabers up over their backs. On an old buck such horns will be forty inches or longer, and are handy for scratching his hips. When jousting, the males do not charge each other. Typically one stands firm while the other rears erect and then, with neck down-arched, crashes down upon his rival; or both may stand erect momentarily before clashing. Since the leading edge of the horn is sharp in male goats, cutting damage might result if the horn hit directly on the head. But the goat on the defensive is too clever to let that happen; he turns his head in the opposite direction of that of his challenger so that the horns cross and the bumpy edges interlock, thus preventing slippage and protecting the head from cuts. Accidents (miscalculations) may happen occasionally, as in all contact sports, but they are relatively few, and serious damage is rare.

A little contemplation of the paragraphs above should illustrate to one the niceties of the natural processes whereby horn, bone, brain, nerves, muscles, and behavior have evolved together. And we append here, as a footnote to our own thinking, the statement that we are amazed that some people, labeling their activities "sport," will with purpose aforethought destroy such wondrous animals as wild goats, tahrs and turs, sheep, and others.

In male goats and ibexes, horn-to-horn contact is not at the base, but usually about one-third of the distance from the base toward the tip. Receiving force in this region, the horns act as levers upon the skull, twisting it clockwise, as

The clash—a millisecond before male Nubian ibex make contact in a ritual "battle" for dominance.

viewed from the left. To compensate for this movement, which might if continued break the neck, the neck muscles which insert under the skull and pull it down are particularly enlarged in goats. What seemingly happens here is a reflex contraction of the muscles just at the moment of, or a millisecond prior to, horn-to-horn contact, to oppose the force of the blow and hold the head firm.

The males of *Ovis*, particularly of the populations with larger horns, have a pattern of jousting markedly different from that of goats. In the first place, the horns themselves are large, heavy, broad in front, and curled around the side of the head. Such horns are indeed veritable rams. A toss of a mature ram's head, bearing such formidable weapons, is sufficient to intimidate an adolescent male, who of course has smaller horns. Rams cannot see their own horns, but they are very aware of the relative sizes of the horns of all other rams—by experience of the force of blows which can be delivered by horns of all sizes. Young rams growing up learn quickly to respect rams with larger horns—i.e., their elders—and, indeed, for much of the year each older ram is followed by a group of younger males, each acting submissively toward him as a female would. The young rams in a group practice against one another, and by the time the members of a group have reached adulthood, they have settled their own position of social dominance amongst themselves. But each of them will challenge any strange ram with horns of similar size to his own. A ram's ultimate goal seemingly is not to acquire females, but to reach such a position of dominance that all other sheep behave toward him as if they were females.

The joustings of the mature rams of large-horned sheep are indeed formidable. Two adult or nearly adult males with horns of approximately equal size who have not previously established their social rank relative to each other will almost always joust. If the opponents are unequal, the decision is settled in favor of the stronger after a few rammings. With a pair equally matched, though, the contest may continue for more than a day and night, marked by fifty or more full-powered rammings. The two will walk away from each other as if unconcerned, then, when some thirty feet apart, will whirl simultaneously and charge with all speed, finishing the charge bipedally. Each tries every possible trick to gain advantage. Particularly, each attempts to use the angle of the edge of one of his broad-fronted horns to cut the other. The other ram protects himself by catching the blow on his horns. So clever are they at simultaneous tricks of offense and defense that some observers have thought the affair to be in the nature of a spirited but friendly tourney. This is not true. No aspect of friendly behavior is involved. Serious damage is rare, and death rarer, but one ram must emerge in the role of a male, the other finally signaling submissiveness by acting like a female.

During each episode of a serious set of rammings, the individual males achieve a speed of about thirty miles per hour before meeting hornbases to hornbases. Each then stands stiffly, head erect and horns displayed, so that the other can see what hit him, before strolling apart—perhaps even to feed momentarily—and then repeating the ramming. Although no one has calculated the forces involved, the impact on horns and heads is obviously terrific.

If two people moving at this speed hit head to head, they die; the force of impact is that of hitting a wall at sixty miles an hour. The rams of course do not die; they live, usually uninjured, to repeat these contests with other rams on other days and in other years. The social system is so organized, however, that no ram is ever an outcast; each has his place in the dominance rankings, and each acts as a male toward those below him but as a female toward those above him.

Both males and females are usually capable of reproduction at the age of two years. Breeding is in the late autumn or early winter of their third year. Females do not compete for mates, and their horns remain relatively small in comparison with those of males. Males will breed successfully at the same age if no older males are around, but in a normal population the older males intimidate the youngsters and keep them from the females. Dominant males do try to keep other males from receptive females, but rarely succeed completely, and do not form harems; nor is monogamy the rule. Indeed, when a female is receptive, she may breed

with several adult males, and almost always becomes pregnant.

Although a young male is capable of breeding at the age of two to three years, his horns are still small, and he dares not assert himself against an adult with much larger horns. Horn growth continues throughout life, which may be as long as twenty years. The major horn growth is, however, achieved by the age of seven or eight years. By that time the young adult male is challenging and defeating any older male whose horns do not match his own in size. Amongst sheep at least, older males with smaller horns are subordinate to younger adults with larger horns; thus neither age nor adulthood is a guarantee of dominance and success in breeding. The evolutionary selection for larger-horned males is balanced in part by the fact that such "successful" males die younger than do smaller-horned adults, who may breed less frequently each season but live to breed over a longer life-span.

There is thus a long adolescence for a male ram, almost a third of his life, during which time the females of his age-group are having a lamb each year. The young males, while capable and willing, are not necessary for the immediate reproductive success of the group, but are a kind of insurance, available if by some chance all adult males are killed.

We should not over-generalize for the several species of Caprini since prolonged behavioral and demographic studies have been made only on the Alpine ibex (*Capra ibex*) and the American bighorn (*Ovis canadensis*), and some behavioral studies have been made on the Barbary sheep. But for the latter, as for *Hemitragus* and *Pseudois*, as well as too often for many species of wild goats and sheep, the published accounts are predominantly those of successful hunters recounting their exploits. This kind of material adds little or nothing to our knowledge of an animal's behavior in intra-group

Male Nubian ibex sparring. Three photos by Uzi Pat, I/C Nature Reserves, Nature Reserves Authority, Kibutz Galuyot St., Tel Aviv, Israel.

associations, his place in the social structure, and his reproductive success. However, the behavior typical of the three species about which we do have good information, backed up by what we know of the male's anatomy in each of the five genera, suggests a similarity of basic pattern for all the Caprini.

Now, after a necessary detour through the subject of the jousting behavior and age-related mating patterns of sheep and goats, we are ready to return to the beginning of our story and to understand why the skulls of different Caprini are built on recognizably different plans. As mentioned previously, if male goats, who merely clash their horns from a standing position, tried the charging ramming of male sheep, the goats would snap their horns, addle their brains, and possibly crush their skulls. The horns and skulls of each species of Caprini have become evolutionarily adapted by natural selection to resist successfully the stresses created by the behavior of their bearers. Thus, we can now begin to understand why sheep and goats, tahrs and turs, and ibexes and others have distinctive kinds of heads and horns.

Careful examination of the details of these structural differences, correlating them with behavioral differences, and working out some other evolutionary implications are what took us so long We will explain some of these details.

Each horn of a caprine (and of all bovids) has two parts. The outer part is a sheath of keratin (horny tissue that develops from the skin, as does a human fingernail). The inner core is bone which is an outgrowth of one of the frontal bones of the skull. Since a bovid has two frontal bones, right and left, it normally has two horns. In all the caprines, as in all large bovids, the center of the bony core of a larger horn becomes absorbed as it grows, making the horn more or less hollow. The space so produced is an extension of the cavity of the animal's frontal sinus on that side, and both frontal sinus and the sinus of the horn (cornual sinus) are filled with air. In male wild goats and ibexes particularly, the cornual sinus may become so large that it extends to the tip of the core, leaving the bony wall at and near the tip paper-thin and fenestrated. In other caprines the wall of bone remains denser and thicker, and thus the sinus is smaller.

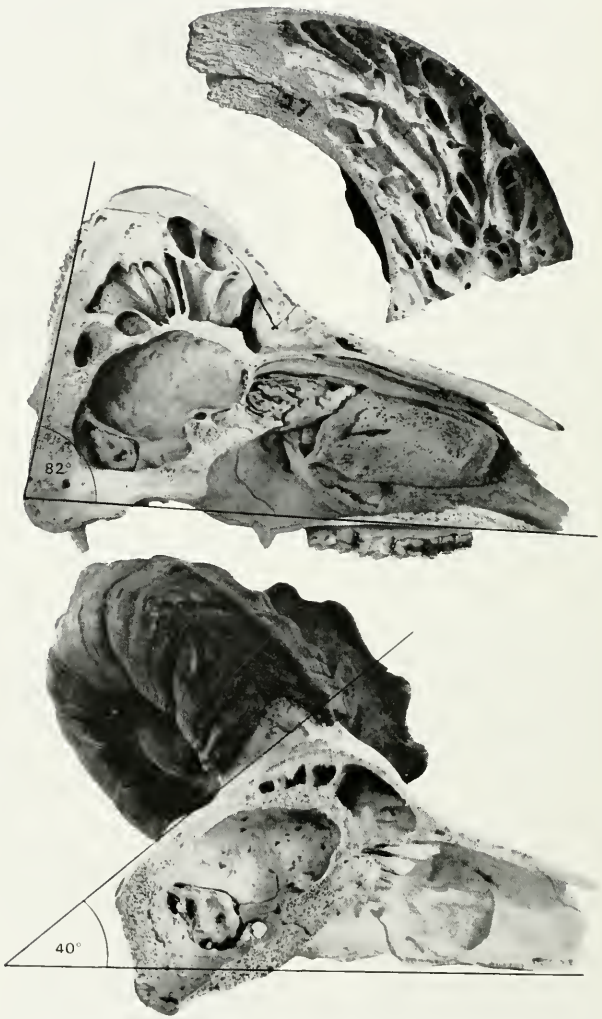
The cornual sinuses are not, however, occupied only by air. When forming, they retain several to many supportive bony struts which cross the sinus. These struts are usually longitudinal in the more goatlike species, while in others (tahrs and bighorn sheep, for instance) they form a complex pattern

like a honeycomb. No matter how complex the interweaving pattern of struts, the cavities are all continuous, all air-filled, and all communicate by way of the frontal sinus with the nasal cavity and thus to the outside air.

Each frontal sinus is confined to one frontal bone and is separated from its partner of the opposite side by a thin vertical midline wall, and each such sinus also has some supportive struts. The sinus typically fills most of its frontal bone. In *Capra*, the frontal bone is smaller than in Caprini with heavier horns, in which the larger frontal bone extends backward to cover more of the brain. Also, in such Caprini with larger horns—the ones that ram instead of merely butt—the skull is bent down sharply at the back, so that all or almost all of the brain lies under the frontal bone and thus also underlies the frontal sinus. In these "rammers"—Caprini with larger horns—we also find the struts of the frontal sinus to be much more numerous, making as complex a honeycomb of bony bars as is found supporting the cornual sinuses of the same individuals.

Our conclusion is that the more the frontal sinuses overlie the brain and the more complex the pattern of struts is in the sinuses—within both the horn core and the frontal bone—the more forceful the male's butting or ramming behavior is. In other words, the behavior patterns are positively correlated with the detailed structure of skull and horns, and the evolution of behavior and structure has obviously gone forward together over long periods of time—several millions of years—in the different populations of Caprini.

During this long period of complex evolution, generation by generation, the forces to which the head was subjected cannot have been so great as to injure the brain seriously. Any male with such an injured brain, whether the individual died immediately or not, was removed from the breeding population and, evolutionarily speaking, ceased to exist.



Honeycomb structure within cornual sinus of *Ovis canadensis* (*top*); and within frontal sinus of *Ovis ammon* (*center*); and *Capra ibex sibirica* (*bottom*). Back of skull is bent down much more sharply in *Ovis ammon*.

The potential types of brain damage, particularly in large-horned rams, are due to deceleration at the instant of contact or rotational acceleration if the heads meet off-center and are twisted.

The results in the brain may be torn blood vessels, compression of tissue, shear, formation of internal vacuoles due to differential pressures within the brain (some possibly much lower than normal), or combinations of these types of damage. Obviously the problem of damage to the brain has been a limiting factor in the evolution of different Caprini, but has probably been most crucial in large-horned *Ovis*. However, just as obviously, the problems have been "met and solved," selected mutation by selected mutation, while the social and behavioral patterns

were evolving. How was all this accomplished?

In the first place, the ram's horn itself, the outer sheath, is thick and presumably somewhat compressable. The shock-absorbing capacity of the bone of the horn core, with its honeycomb of supportive struts, must also be considerable; and it is "backed up," so to speak, by the system of struts below each horn, in the sinus cavity of each frontal bone. Finally, there is a correlation between the spot of impact—on the broad front of the horn directly above the forehead—and the fact that the whole of the back part of the skull is bent sharply downward. The direction of the force of the blow and the direction of the transmission of that force through the centrally bent posterior part of the skull are the same, and this line continues through the anterior vertebrae of the neck. Thus, in normal ramming, there is no tendency toward rotation of the head as occurs in goats, and the problem of whiplash is diminished. A structural correlation is that sheep do not need the enlarged ventral neck muscles of goats, and do not have them.

During the several million years of evolution within the Caprini, the usual evolutionary processes of mutation, differential selection in slightly different habitats, and geographical isolation have resulted in adaptive radiation within the group such that we now recognize five genera. Of these five, the goats (*Capra*) seem to be the least specialized for intense jousting by virtue of the structure of skull and horns. Jousting among male goats and ibexes—and also incidentally in the small-horned European sheep—is not forceful enough for any marked correlated changes in the shape of their skulls to have evolved. The angle between the plane of the palate and the plane of the back of the skull remains low (27°-48°) in these animals, in contrast to the angle (74°-92°) in the more specialized, large-horned animals with the backs of the skulls bent down sharply.

Clearly, the most specialized of the Caprini are the large-horned sheep of the genus *Ovis*. But even within the sheep there are differences. Those in western Europe have smaller horns and less specialized skulls (and hornless females, whatever that may mean), and Asiatic sheep generally have larger horns with correlated specializations of the skull, as do the North American sheep, which descended from late immigrants from one of these eastern Asiatic populations.

Evolutionary selection for behavior, population structure, and anatomy of head and horns has obviously occurred simultaneously for several million years. To have evolved a social system that allows the luxury of capable young males not reproducing until half their life is gone demands two conditions: several million years of evolution of behavioral patterns so that such a social system works; *and* the continuous presence of older males, generation after generation, to maintain a continuity of population pattern which would channel the evolution.

Obviously, the locomotor adaptations which allowed invasion of rocky hills and mountains have been long successful in the Caprini, and built upon that success came such certainty of population structure that the subsequent secondary and then tertiary adaptations we have been talking about did evolve.

We cannot say why the special evolution of the Caprini began to evolve in the way it did, when that of another crag-loving bovid, the Rocky Mountain "goat," proceeded quite differently. The males of this species do not usually "fight," no dominance is established, and the young breed as soon as they are physiologically capable. Jousting would be particularly dangerous in these animals because their small, straight, sharp horns can inflict extremely dangerous and often fatal stabbing wounds; even an adult could be killed by a youngster.

The different pattern that the Caprini as a whole exhibit indicates that a common ancestor began to evolve several million years ago away from an animal also ancestral to the chamois. In the Caprini, this combined anatomical, behavioral, and social evolution was toward larger horns, male jousting, exclusion of the young males from breeding, and consequent extended adolescence.

So we have come full circle. The differences between skulls of sheep and goats which puzzled Reed in 1955 are better understood now in 1972. But we had to take a long way around—through comparative study of the behavior, anatomy, and population structure, as determinable, of all caprines and some of their rupicaprine cousins, and put these factors into an evolutionary framework. This circle is spotted with gaps though, because we don't yet have intensive studies in nature of many of the caprine populations. The unstudied groups include Asiatic sheep and Asiatic goats, the single species of *Pseudois*, the three species of *Hemitragus*, and to a lesser degree the single species of *Ammotragus*.

There remains much research to be done by the field-naturalist—research of the kind now called ethology, the scientific study of the behavior of individuals and populations, as related to evolution, of free-living wild animals. These studies can be aided by modern techniques of telemetry and motion picture photography. Such studies must be done while natural populations remain to be studied!

FURTHER READING

Valerius Geist. *Mountain Sheep: A Study in Behavior and Evolution*. Chicago: University of Chicago Press, 1971.

William M. Schaffer and Charles A. Reed. "The Co-evolution of Social Behavior and Cranial Morphology in Sheep and Goats," *Fieldiana: Zoology*, vol. 61, no. 1, 1972.

Dr. Charles A. Reed is professor of anthropology, University of Illinois at Chicago Circle, and research associate, Department of Zoology, Field Museum. William M. Schaffer is a graduate student in the Department of Biology, Princeton University.

international nature photography exhibition

Almost 900 people, from every continent except Antarctica, entered this year's Chicago International Exhibition of Nature Photography held at Field Museum recently. The slides ranged in subject matter from insect and flower close-ups to desert vistas and ocean shores. The prints were fewer in number but covered much the same range in dramatic black and white as well as color. The photographers are all amateurs, and no one receives any monetary reward—only the satisfaction of having been thus recognized in the largest nature photography show of its kind in the world.

Some people maintain that photographers fail to see many things around them because of their concern with what makes a good picture. I am sure that this is not true. The search for good photographs demands an even keener and more persistent eye than someone without a camera is likely to have. Looking for new photographic possibilities is as fine an introduction to the depths and subtleties of nature as one can hope to find.

This annual exhibition, having been held now for 27 consecutive years, allows amateur nature photographers to share the discoveries and insights they have captured on film.

William Burger
President, Nature Camera Club of Chicago

***Autumn Silhouette,* by Bernice H. Fredericks, Elmwood Park, Illinois.**

Running Scared, by Henry A. Schull, Darien, Connecticut.

Free Ride for Baby, by T. S. Lal, Quilon, India.

Possum Quartet, by Evelyn Boos, West Brookfield, Massac

Take Off, by Alex H. Sharp, Port Elizabeth, South Africa.

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Damsel Fly at Rest, by Roy M. Van Loo, Jr., Battle Creek, Michigan.

A tale from the south pacific

John Terrell, assisted by Sampson Purupuru

Bougainville, the largest island in the Solomons, fell for the first time under the gaze of an explorer from the Old World early in July 1768. The captain of the frigate *Boudeuse*, on a voyage of discovery around the globe, came upon the island from the south and sailed along the east side until he reached what he called a "remarkable promontory" on the northeast coast. He gave to that point of land the name by which it is still known, "Cape l'Averdi." To the regret of history, he did not go ashore.

If he had, we might today have invaluable documents about the villagers of north Bougainville and the little island of Teop, which lies on the south side of the harbor formed by Cape l'Averdi. They would be documents from the very dawn of history in the North Solomons.

But no, the Frenchman moved on, traveling northwest, until he found a neighboring island, smaller than Bougainville, but one which seemed thickly inhabited. Natives came from the island in canoes, shouting *bouca, bouca, onellé.* Efforts to befriend them failed, however, and the *Boudeuse* sailed on.

History has awarded that captain many honors. One was the privilege of naming the smaller island to the north *Bouka*, or as it is written on maps today, Buka. Another is the distinction of having one of the most majestic isles in the South Seas named after him, for he was the famous explorer Louis Antoine de Bougainville.

In this fashion the island of Bougainville passed from its long prehistory into written history. But only in a fashion. For although the many other islands in the great Solomons chain experienced the heavy impact of 19th century European expansion, Bougainville and Buka lay shadowed from close scrutiny for a hundred years more.

One reason may be that the natives gained an unsavory reputation. As late as 1916 the *South Pacific Pilot* could report: "Owing to the ferocity of its inhabitants, Bougainville is less known than any of the larger islands of the [Solomons] group, and no white man is (1887) believed to have penetrated its interior."

Inevitably, nonetheless, history caught up with the islands. The Germans claimed the region in 1886. By the end of the first decade of this century, government, mission, and commercial stations had been established on the coast of Bougainville.

But traders' memoirs, government reports, and mission records are rarely the stuff from which full history can be written. The transition from prehistory to history was slow. Most of what the world beyond the Solomons knows about Buka and Bougainville must be credited to those scholars who have gone to the Pacific precisely for the purpose of making written records—the anthropologists.

The German ethnographer Richard Thurnwald worked in southern Bougainville in 1908-1909. An Englishman, Gerald Wheeler, obtained indirect material on Bougainville while studying the Shortland Islands just to the south in those same years. In 1911 another German, Ernst Frizzi, brought back a great deal of useful information, again largely on the southern villagers. Between the two world wars, the anthropologists Beatrice Blackwood and Douglas Oliver each lived long enough in the area to write detailed ethnographies. Since World War II the pace of scientific study has increased many times.

Thus, although there is much to be done, today it is possible to write a great deal about the languages, cultures, and peoples of both Buka and Bougainville.

Yet the scholars who have gone to the North Solomons have dealt directly only with contemporary life there. And the customs of the present day are not those of the prehistoric past—due in large measure to the impact of

European civilization. Life on the islands has changed deeply and fundamentally since the *Boudeuse* sailed along the coast.

If the past is to be written for these islands, it will not be the anthropologists, nor the missionaries, nor the government officers who will write it, although their contributions will be extremely useful. Nor will the islanders themselves be in a position to write what has been forgotten.

Telling the story of the islands before the arrival of the white man will be the task of archeologists. Since it was once the common belief that the Pacific had nothing to offer the archeologist, that conclusion may come as a surprise. Nothing to offer? We now know men could never have been more wrong.

Modern scientific archeology reached out into the Pacific only after World War II. Almost at once the discoveries were shattering. Not only could the islanders be shown to have a past well worth studying, they also had an ancient past. We now know, for example, that the ancestors of the Polynesians of the eastern Pacific—far from having migrated out of Asia or the Americas in the recent past, as many academics have long maintained—were living in the Pacific for thousands of years. The prehistory of the islands farther to the west is now believed to extend back well into the era of the Ice Ages.

Ancient time as such is not the attraction of Pacific archeology, however. If archeologists were fascinated merely by old things, then there would still be far better places in the world to go. What makes the Pacific so intriguing is far more subtle. That subtlety has many shades.

For one thing, the peoples of the Pacific islands have only recently left prehistory and joined the technological age. In many areas we know enough about the anthropology of the islanders before industrialization to use that knowledge to help develop theories about pre-industrial man, and then try to test those statements by looking back into the archeological past. In the old centers of urban civilization, of course, prehistory lies in the dim mists of time before Egypt, Greece, and Rome. Not so in the Pacific.

Another reason for exploring the past of the islands is that the peoples, scattered as they are on flecks of land spread over thousands of miles of ocean, have developed seemingly unique ways of life in comparative isolation. Their adaptations to the tropical world are many and varied. The opportunity is there, in other words, for both anthropologists and archeologists to examine the causes and conditions leading to human diversity and change.

Like history, archeology came to the North Solomons only recently. R. J. Lampert, from the Department of Prehistory at the Australian National University, visited Buka Island in 1966 to survey the prospects for archeology. He was followed a year later by J. R. Specht and his wife, also from Australia. They spent over half a year collecting archeological materials and excavating ancient village sites. He was able to establish a chronological framework based on pottery types that could be carried back well into the centuries we call B.C. The Spechts also visited the Bougainville coast across from Buka and found there a number of old village sites which clearly indicated that Bougainville too would yield much to an archeologist.

In 1967 the first steps were taken at Harvard University for a program of archeological exploration and excavation on Bougainville that I would direct. I was then a graduate student at Harvard, but had been out in the Polynesian Islands before, in 1965, as a Fulbright Fellow. I decided to return again to Oceania because the intricate cultural, biological, and linguistic complexity of the islands in the western

Pacific appeared to offer an unparalleled chance to study the causes of human biological and social differentiation by using both anthropological and archeological evidence.

I lived on Bougainville throughout 1969 and the first months of 1970. With the assistance of local men, I explored four separate areas on Bougainville: two on the north coast, one on the east coast, and one on the inland plain at the southern end of the island. Forty-five crates of archeological specimens were collected and brought back to America for laboratory analysis: potsherds, stone axes, discarded refuse bones and shells from kitchen dumps, carbon and soil samples, and twenty-four notebooks filled with archeological and ethnographic information.

It should hardly need saying that the analysis of so much material is not yet finished. Work on the Bougainville survey is continuing, not in the field, but in the Field Museum, where I am working with students in the Laboratory Research Training Program offered by our Department of Anthropology. The results will eventually be published as an archeological report.

But archeologists write only one kind of history or prehistory. Different peoples of the world have their own folk prehistory. It is not derived from potsherds and soil samples, and it is transmitted as oral tradition. If traditional mythology, history, and thought are to be recorded, the local islanders themselves are in the best position to undertake the task.

Therefore, Sampson Purupuru and I wish to record here the story of the founding of the Teop Island people, a tale of legendary prehistory, as told by a Teop Islander. This story is widely known by Teop-speakers in north Bougainville. It is rarely told to foreigners, because the people fear that the honest, graphic reference to the origins of female sexuality may offend them. They hesitate also because they suspect that others may not respect the integrity of the story, and only laugh at the tale as beyond comprehension.

When I was staying on Teop Island, just off the northeast coast of Bougainville, Sampson Purupuru, the island's representative in the Teop-Tinputz Local Government Council, on which he serves as vice-president, told me the tale of the Woman of the Trochus Shell, the first woman in the Teop world. We discussed her history often in the months that followed.

Her name, Topusubie, literally means "one whose accustomed abode is the shell of the Trochus." The Trochus, *T. niloticus*, is a marine gastropod with a pink, conical shell that has been used for many years in the West to make shirt buttons. Her legend, as told by Purupuru, fully explains why she should bear such a name. The tale is about the first man in the world, who lived at an ancient place called Namatoa, in the mountains of north Bougainville, and Topusubie, who lived down on Teop.

Topusubie, Woman of the Trochus Shell, as told by Sampson Purupuru

Long ago the one man here lived at Namatoa up in the hills overlooking Teop Island. And the one woman who lived here lived on Teop.

Every morning she would clean the beach with her *ihiana* [a kind of wooden broom] from Teobebe where the [Methodist] Mission used to be as far as Pahokai on the other [west] side of Teop. The man, sitting up in the hills, watched her every morning. He did not know what she was.

"What is that? A man, a dwarf, a devil, or what?" So he decided: "I think I must go one day and see."

He came from Namatoa one evening and stayed on the coast after building a *tanuvu* [a reef house]. He thought he had to come across [on the reef] early in the morning and see what it was, while it was cleaning the beach.

So next morning at low tide he walked across to Teop Island. The woman saw him and ran quickly to her hiding place, which was a Trochus shell. Her name, Topusubie, means the shell of the Trochus.

The man tried to find her. He followed her tracks. Sometimes he even moved the shell with his feet. But he did not know she was inside. So he went back into the hills.

Now he came down again several times. In the morning he would see her once more. Each time, however, the woman would always hide. Finally he decided: "Oh, I think I must try and go by the other side." But on the other side was deep water. You can only approach by paddling a canoe.

He came down the next morning and started to make a *panasu*, a raft. He spent all day doing that. Then in the late afternoon he came across on the raft. He put it at a place they call Teobana on the west side. He stayed there all night waiting for the next morning.

And in the morning he walked across the island to Teobebe where the woman lived. He saw the woman and hid in the bush when the woman was cleaning the beach. He thought: "What can I do to get her to belong to me?" He hid for a while and then jumped out from the bush to the beach. He put his hand on the woman's shoulder. She had no time to get back to her hiding place.

She asked him: "Where do you come from?" And the man said: "Namatoa." She asked him: "Why do you come here?" And the man told her the whole story about seeing her and trying to catch her.

The woman tried to get away, but the man was strong. He said to her: "No, I would like you to be my wife."

They talked for some time. Then they settled and they lived. The man did not go back to Namatoa again, because they married.

But he was not happy. He was a man, but she was not fully a woman. The man decided to make something.

He broke a shell which we call *boen* [the black clam] into pieces. He took the pieces back to the bush with the woman and told her to climb the *vioga* palm [a small variety of betel-nut tree]. The woman climbed the tree.

When she was half-way up, the man made the broken pieces of shell ready. When the woman reached the top of the tree, he put the broken shell into the trunk in a row going up the tree.

Then he said to the woman: "Don't look down, but slip very quickly." And she did so. When she slipped down quickly, she was cut by the broken pieces of shell. And there was blood all over.

When the woman saw that, she said: "You spoil me. Look. Blood is all over me and the tree." The man said: "No, I didn't spoil you. You will see the new things I do." So in this way the woman became a woman.

When you see the *vioga* tree, you will find that part of the *vioga* is red. That is the blood, which came from the woman. When she was well, they started to make their family.

This is how the man came to Teop. And all the people of Teop came from these two, generation upon generation. The man belonged to the clan Amara. The woman belonged to the clan Naomutana. Both clans come from these two. This is the old story.

Another version of this story was reported a generation ago by Beatrice Blackwood of Oxford University, who lived on Buka and in north Bougainville from September 1929 to October 1930. Unfortunately she was able to make

only a brief visit to Teop Island, but Purupuru remembers that she spoke at length with his influential father, Toave. Sampson was a boy at the time, and vividly recalls leaning on her legs while Miss Blackwood and his father conversed.

Scattered through her anthropological report *Both Sides of Buka Passage* (Oxford, 1935) are references and allusions to the Teop people. Of special interest here is what she wrote about a legendary woman named Topisbi'e and the role she played in the origin of the matri-sibs or "clans" of the area.

On Buka and Bougainville, kinship follows a system of named matri-sibs. Each is composed of those who claim common descent through maternal kin from the same legendary figures of the past. Each has what has often been called in the anthropological world "totemic" associations with certain species of plants and animals, certain human characteristics, certain places and things: that is, associations that help to signify a sib's common identity.

Blackwood wrote: "With every clan there is associated the name of a certain creature, generally, but not always, a bird." As Purupuru explains, if a man meets a stranger and does not know if he is a kinsman, he will ask of him: "What is your bird?" In other words: tell me your clan name, not directly, but by that which signifies it.

Sampson Purupuru

Traditionally a man must not marry a girl of the same matri-sib, although the strength of that "incest taboo" decreases with genealogical distance. And to reiterate, in this part of the world, a man takes his sib—in our terms, his "name"—not from his father but from his mother.

The origin of these named kinship groups of Buka and north Bougainville are traditionally explained, according to Blackwood, by very much the same legend throughout the area. An old woman, left alone when her people fled a monster, conceived through artificial means and bore two sons, who killed the monster. The people who had fled returned home. Her sons married, and from the two couples all people are descended.

In her report, Blackwood quoted extensively from one origin myth of this sort, told her on the island of Saposa at the northwest side of Bougainville. She then wrote: "A version of the same story obtained at Tiop, however, carries it a stage farther [than the tale from Saposa]. Here the woman is called Topisbi'e. When enough children have been born, and she has assigned a clan to each of them, she says to them: 'You, Naboin, must not eat the eagle. You, Natchi, must not play too much in the sea. You, Nakahi, must never kill a dog. You, Nawaniu, must not chase the bush-fowl. You, Amara, must not play with the turtles. These things you must tell to all children who are kin to you.' " Each name mentioned is a matri-sib name; each taboo is a totemic restriction recognized by those of the sib designated.

We can only express regret that Blackwood did not tell us more about the story of Topisbi'e, for there is no doubt she might have recorded much that has today been forgotten. It is certain, however, that Topisbi'e in Blackwood's rendering of the ancestress of the Teop people is the Woman of the Trochus Shell, Topusubie.

Spirit stones at Teobebe.

Topusubie also figures in a way in the archeological prehistory of Teop. Back in 1935, Beatrice Blackwood reported:

> At Tiop, an island at the north-eastern corner of Bougainville, there is a group of stones which are . . . flat slabs of limestone, apparently unworked. There is no trace of a design upon them. There are two large slabs and two smaller ones . . . .
>
> These stones represent a man and his wife and their two children. The whole group goes by the name of Tohihiu. They are said to 'belong to' a man living in the village, who is of the Nakarib clan; he was described as their kinsman.

Blackwood goes on to relate that whenever a feast is held to mark some epoch in the life of a child of the Nakarib clan, the child is taken to these four stones. Not long before her visit, such an event occurred. When she examined the stones, "there were

still traces upon them of the red paint with which they had been smeared on that occasion." As she observed, red "paint," an ocherous earth called *oné* obtained by trade from the mountain Rotokas people at the center of Bougainville, is a sacred substance which plays a part in many island ceremonial activities.

These stones are still to be found, along with others, on Teop Island. They stand on the east side of the island at a spot called Teobebe (a name meaning "Abounding in Butterflies")—the very place of Topusubie's secret abode in the Teop legend. They are not of limestone, but volcanic rock. They must have been imported to the coral-sand island of Teop from the nearby mainland of Bougainville. The largest stands 44 inches above the ground.

For want of a better term, we will call stones such as these "spirit stones." Throughout the North Solomons certain stones are linked with mythological or ancestral figures. One hears of stones that are demons. Stones that move about. Stones where spirits dwell. Stones that are, in fact, ancestors or legendary characters turned to stone. Such remarkable stones have names. They may be "owned" by a particular group of kinsmen, who know the tales connected with them.

The anthropologist Richard Thurnwald, who worked in southern Bougainville in 1908-1909, wrote, for example:

> . . my attention was drawn to some big stones of which legendary stories were told; sometimes a man exhibited peculiar behaviour when he passed such a monument. At one he would spit, on another lay fern leaves, upon another shoot an arrow, or he would put his hand upon the stone and then pass by without touching it again, or he would address some words to the stone threatening it with a small spear such as boys use when playing.

In appearance, spirit stones vary greatly. Most stones that Sampson and I saw are natural boulders or rocks. Some had grooves and basins cut into them, suggesting that at some point in their history they were used to fashion stone axe-heads. Blackwood, on the other hand, saw several stone "pillars" in the Buka area, a few of which were incised with geometric patterns. Recently a similar incised pillar was discovered on Pinipel Island, over fifty miles north of Buka.

Those of the region in and around Teop Island, nevertheless, show little if any shaping by the hand of man. The most elaborately worked stone is at Irue Village on the Cape l'Averdi point. It is a rounded, elongated boulder, 28 inches long, belonging to the local Navanieuvu matrilineage or "family." On one side there are several basins, a groove, and small pits. The other side has been modified more clearly to represent a female figure, named Kavokohi. Unfortunately, her story has been forgotten.

The four at Teobebe are unworked, as Blackwood mentioned. Her attention was directed to them at the very end of her stay in the North Solomons. She expressed regret that she was unable to investigate them more fully. Now, over forty years after her visit to Teop, we may be able to cast more light upon them.

Today the stones are linked strongly with the legend of Topusubie, who is said to be the second largest stone. In other words, she has turned to stone. The larger is her husband, the Man from Namatoa. And the two small ones are, of course, their chidlren. People are able to remember with confidence only Topusubie's name.

My interest in the four led to a great deal of discussion on Teop Island. In particular, Hanaiteopas, an old man who remembered Blackwood's journey to Teop, disagreed with Koveu, an old woman who became my "mother" on the island. Hanaiteopas declared that the name of the Man from Namatoa was Tohihiu (the very name for all four stones as reported by Miss Blackwood). Koveu, on the other hand, denied the truth of what Hanaiteopas claimed. Yes. Topusubie was the name of the second largest stone, but the name of the man-stone had passed from memory because he was not, after all, from Teop.

Koveu

The debate between "mama" and the old man continued for weeks. One of the most difficult points was what matrilineal family owned the stones. The Naokaripa family were supposed to be the owners. But the legend is clear that Topusubie and the Man from Namatoa were not the direct ancestors of that family. Therefore, the Naokaripa family could not be the rightful owners of Topusubie.

The argument was finally resolved in this way. It was decided that the Naokaripa family did not own Topusubie and her family, but another stone, called Togamirisoa, elsewhere on Teop. The Naokaripa family, in other words, must have gone to the wrong stones when they came for a ceremonial visit to Topusubie just after World War II. That visit must have started the confusion about ownership. The families who actually owned the four stones at Teobebe had to be the Amara and the Naomutana, the families descended from Topusubie and the Man from Namatoa. Some people concluded that Tohihiu was the name for the Man from Namatoa, and also the largest of the four stones. Others said, no, Tohihiu was the name of another stone north of Teobebe. Mama, however, said Tohihiu was not a man-stone at all. Tohihiu was a woman.

Confusion! To add to it, we must remember that Blackwood herself reported that all four stones at Teobebe were owned by the "Nakarib clan": that is, the Naokaripa who visited them just after the war. Thus, the only thing we can be certain about is that the four stones called Tohihiu by Blackwood are the same four called Topusubie today. We know that because she has a photograph of them in her book.

All of this uncertainty does show one thing very clearly. Legendary prehistory is *not* the same as archeological prehistory. Stones stay around. In or above the ground. But legends inhabit only people's minds.

But if archeology rarely is able to say very much about folk prehistory, anthropology also runs into trouble when it attempts to talk about factual prehistory. Blackwood speculated in her book that the spirit stones of Buka and north Bougainville "may perhaps once have formed part of an elaborate fertility ritual, most of which has now been lost." We can think of no way to discover whether she was right about the distant past. Today, we can only say that her suggestion does not genuinely apply.

Some spirit stones in the Teop area are "used" as they were in Blackwood's time: by certain families during ceremonies marking important phases in the growth of their children. According to local custom, food is taken to the stones every time a child's "growth feast" is given, in order to announce to the family's ancestors that such an event is taking place for their children.

Other stones may be used for yet different purposes. The stone called Vasintaono on Teop, for example, is visited by women to gain its assistance in catching fish. There is another, called Matanateasubui, on Cape l'Averdi, which is used for the same purpose.

We say that spirit stones are used in these various ways. We must add, however, that the old customs of the Teop people are dying. And with them, the importance of the stones.

I excavated at Teobebe, near the stones of Topusubie. The archeological specimens I found in the ground tell a version of Teop prehistory going back hundreds of years. But the legend of Topusubie can never be dug from the ground.

That is why we have told her story here. In this way Topusubie will not be forgotten in time.

John Terrell recently joined the Field Museum staff as assistant curator of Oceanic archeology and ethnology. On Teop Island he is a member of the Namae family, and is known as Kamahira. Sampson Purupuru is vice-president of the Teop-Tinputz Local Government Council. He is a leader of the Navanieuvu family on Teop.

BOOK REVIEWS

Mountain Sheep: A Study in Behavior and Evolution

By Valerius Geist. Chicago: University of Chicago Press, 1971. 383 pp. $14.50.

I am always happy to read and review a good book, one both interesting and at the same time contributing greatly to our understanding of life and evolution. Geist's fine book is the result of several years of intense and patient observation of wild Stone's, Dall's, and bighorn sheep in the Canadian Rockies, supplemented with wide reading and a thorough grounding in the science of animal behavior (ethology).

The main value of Geist's work, in comparison with most monographs on the natural history of a species, is his predominating evolutionary viewpoint, particularly with regard to natural selection, found in his discussions and conclusions. He also has a firm intellectual grip on the history of the Pleistocene (Ice Ages), and interprets the morphological and behavioral evolution of his sheep against the changing environmental history of the past several hundred thousands or even millions of years. Such breadth of view, too often lacking in ethologists, is particularly welcome with regard to sheep (*Ovis*), the species of which have had a northern circumpolar adaptive radiation and so present a most fascinating study of the evolution of the several species within a genus as laid against the major environmental turmoil of world-wide climatic changes and the advances and retreats of continental glaciations of the Northern Hemisphere during the Pleistocene.

Those more directly interested in natural history will be pleased to know that the bulk of Geist's book is devoted to the results of his own observations, over several years, on the behavior and ecology of the three groups of sheep in the Canadian Rockies. Geist, for the first time, has worked out the intricacies of the social organization of wild sheep and given a logical explanation, in functional terms of that social organization, for the spectacular bouts of head-rammings between pairs of adult and near-adult males of sheep of North America and elsewhere. In short, those males are impelled by reason of their genetic endowments for maleness in their particular social organization to try to achieve social dominance—that is, to get all other sheep to act toward them as females would. Such social dominance is achieved by having larger horns and greater force of ramming than one's opponent while at the same time withstanding his attacks successfully until suddenly he switches from the behavior of a male attacker to that of a submissive female. A by-product of winning social dominance, a result certainly not planned with forethought by any ram, is that during the rutting season he mates more often with more females than do males below him in the dominance hierarchy.

Geist's book is obviously packed with much more information about the life history of American wild sheep than I can outline here. Those particularly interested in the details of the "life and times" of one of America's most splendid of wild mammals must consult the book, illustrated as it is with 89 photographic plates plus many line drawings.

I do not do Geist a disservice when I differ from him with regard to one of his interpretations; scientists, like rams, make progress when they test themselves against each other. Geist (p. 177, and elsewhere) argues against the horns of rams having evolved as a selective response to absorb concussion. The anatomical studies of myself and my colleague William Schaffer, outlined elsewhere in this issue of the *Bulletin*, indicate firmly to us that rams' horns (and also heads) have most definitely been selected, and thus have evolved, in correlation with the extreme forces of concussion to which rams are subject in their fighting for social dominance. Geist's statements that rams with larger horns win higher dominance rankings and that those rams then beget the larger proportion of the next crop of lambs strengthen our conclusion, based on anatomical evidence, that selection favors those rams which not only have the larger horns but also can withstand the greater forces of impact.

Minor differences of viewpoint aside, Geist's book is a superb one, and I commend it to all interested in natural history or problems of mammalian evolution.

by Dr. Charles A. Reed, research associate, Department of Zoology, Field Museum.

Exotic Plants

By Julia F. Morton. New York: Western Publishing Co., 1971. 160 pp.; about 400 color illustrations. $1.25 paperbound.

The word exotic in the title should and does mean those plants which have been introduced from foreign lands, but the word is also used to mean exciting or glamorous. Many of the plants shown in the book are exotic in this second sense of the word.

Mrs. Morton's guide covers those plants which will grow out of doors in tropical and subtropical regions of the world. Some 400 plants are covered in this small "pocket-sized book," which would serve as a guide to the commonly cultivated showy plants for the amateur plant lover traveling or living in the tropics or subtropics of America.

The text is brief but adequate. The illustrations are the work of several artists and are somewhat uneven in quality, but will serve their purpose of easy identification. To get some 400 illustrations, plus text, on 160 pages requires some accommodation—and there have been accommodations.

by Dr. Louis O. Williams, chairman of the Department of Botany, Field Museum.

NSF Grant for Analysis of Isimila Site Materials

Field Museum has been awarded a grant of $37,600 by the National Science Foundation for support of research entitled "Analysis of Isimila Site Materials." The two-year program is under the direction of Dr. Glen H. Cole, associate curator of prehistory at the Museum, and Dr. Maxine R. Kleindienst, presently of Toronto, Canada.

Isimila is located in the Southern Highlands Province of Tanzania, Africa. It is considered to be of particular importance because of the profusion of stone implements that were found in archaeological context in the various horizons of human occupation at the site, dating from the Middle Pleistocene Epoch.

The tool-making culture is known as Acheulean, after the place (St. Acheul) in northern France where well known occurrences of such tools were found. Estimates place the Acheulean culture from about 75,000 to 500,000 or more years ago.

Isimila, an undisturbed site, was discovered in 1951 as a result of extensive erosion that exposed a large number of stone tools. Steady deposition of sand and silt in a basin that had alternately been a marsh and shallow pond eventually filled it to a depth of more than 60 feet.

Five distinct beds of coarse sediment were found. The top three layers, which were liberally covered with artifacts, were excavated extensively. The uncovering of several occupation areas on each level, nine in the upper three and one in the fourth, provided an opportunity to compare different assemblages of tools known to be roughly contemporaneous.

The Acheulean industry at Isimila comprises a wide range of implement types, including hand-axes, cleavers, scrapers, choppers and picks, made from a variety of stone material. The many types of tools found at various places within a single level indicate different activities by members of the same group. The variations in style may also suggest that more than one group of early men occupied the site.

Before the excavations at Isimila, different assemblages of tools had always been found at separate sites, or in other levels at the same site. The discoveries at Isimila provide an entirely new idea of the full range of the Acheulean tool complex, and reveal an unsuspected degree of specialization.

The Isimila site is also important because of its strategic location, the multiple horizons of former human occupation, and the preservation, though only fragmentary, of fossil animal bones.

Much of the material excavated from the area is now at Field Museum, and the balance is at the Tanzania National Museum at Dar Es Salaam.

Because of the work at Isimila, some widely held theories about the activities of early man have been revised. Upon completion of the current research project, Field Museum Press will publish a book on the Isimila site.

Laboratory Training in Archeology

Eleven students from local schools are participating in a research and training program in archeological techniques at Field Museum under the direction of John Terrell, assistant curator of Oceanic archeology and ethnology.

Terrell arrived in Chicago last fall as a "package deal" for the Museum: a new assistant curator of anthropology complete with his own research collection consisting of seven tons of artifacts from Bougainville Island in the South Pacific.

Each student is carrying out a project under Terrell's guidance for course credit at his own school. All are charged with analysis of excavated materials from the diggings on Bougainville. Most are learning the ropes of pottery analysis and interpretation; several are studying "midden" bones and shells from old food dumps to try to discover something about prehistoric diet and economy on the island. One student is editing Terrell's ethnographic notes. The students are: Dan Cwiak (University of Illinois Circle), Joan Franzel (Northeastern Illinois University), Betty Haynes (Museology student at the Museum from Waller High School), Dan Hogan (Northeastern), Shelley Lewis (Roosevelt University), Jennie Masur (University of Chicago), Susan Moore (Northeastern), Steve Peters (Northeastern), Sue Sanchez (Roosevelt), Tom Smith (Roosevelt), and Marty Zelenietz (Northeastern).

Course in Geology of Chicago Region

Field Museum, in cooperation with the University of Chicago, will offer a five-week course for laymen on "The Geology of the Chicago Region," beginning April 15. The course includes an introductory lecture and four all-day field trips conducted by Dr. Matthew H. Nitecki, associate curator of fossil invertebrates in the Museum's Department of Geology.

The introductory two-hour lecture, April 15 at 10 a.m., will be at the University of Chicago Downtown Center, 65 East South Water Street. The field trips are: April 22, 8 a.m., to Palos Park; April 29, 8 a.m., to Thornton and Wilmington; May 6, 8 a.m., to Kentland, Indiana, May 13, 7 a.m., to Starved Rock.

In Palos Park, course participants will see rocks representing a four-hundred-million-year-old shallow tropical sea that once covered the area. Glaciers advanced and receded, leaving behind millions of tons of unconsolidated materials. Some of this material formed ridges, called moraines, behind which undrained ponds and marshes remained.

Eighty miles west of Chicago, at Starved Rock, a different geological record will be viewed. Here the sandstones, limestones, and shales of the Middle Paleozoic era, some half a billion years old, have been gently deformed, giving us the spectacular fold, or anticline, in the picturesque canyons of the Illinois River.

At Thornton and Wilmington, 60 miles south of Chicago, course participants will have the opportunity to collect some unique fossils in a coal mine, including three-hundred-million-year-old denizens of the shallow sea which once covered this part of Illinois.

Further south, in Kentland, Indiana, a geologically puzzling structure of much disturbed rocks, called cryptovolcanic, will be explored.

The field trips will be by chartered bus. Tuition is $60 for the four trips and the introductory lecture; $33 for two trips and the lecture; and $18 for one trip and the lecture.

Dr. Nitecki is also conducting a one-week field trip to the Missouri Ozarks March 26 to April 1, for which tuition, including transportation, is $140. Anyone interested in joining this trip is invited to a preliminary meeting Saturday, March 4, 10 a.m., at the University of Chicago Downtown Center.

Members of Field Museum are eligible for a discount on both programs. For further information, please call Mrs. Maria Matyas at FI 6-8300.

CALENDAR

Exhibits

Opens March 10

Morton Arboretum: 50th Anniversary, a small commemorative exhibit. Through June 4. South Lounge.

Through March 5

Coco-de-mer, an exhibit of the world's largest seed and its use by man, on display in the South Lounge.

Continuing

Australian Aboriginal Art from Arnhem Land, a selection of nearly 400 bark paintings and some wooden ceremonial sculptures. The exhibit is unique because of the documentation accompanying most of the pieces, including when they were painted, their use, the region in which they were produced, and information about the artists. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in Lower Illinois River Valley, an exhibit exploring the "new archaeology" as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Eleven successive habitations, dating from 5100 B.C. to A.D. 1000, are yielding information about man's adaptations to his changing environments through time. Through September 4. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

Hours

9 a.m. to 5 p.m. Saturday through Thursday; 9 a.m. to 9 p.m. Friday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare first-edition volumes is featured each day. Continues indefinitely.

Free Film Program

March 12

"Everything You've Always Wanted to Know About Volutes but were Afraid to Ask," slide lecture presentation narrated by Jean M. Cate, offered by the Chicago Shell Club at 2 p.m. in the Lecture Hall.

March 26

"West Side Story—Mexico to Alaska," wildlife film narrated by Walter H. Berlet, offered by the Illinois Audubon Society at 2:30 p.m. in the James Simpson Theatre.

Continuing

"Patterns for Survival" (A Study of Mimicry), presented at 1:30 p.m. and 3 p.m. on Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

"Chinese Jade Carving," shown at 2 p.m. and 3:30 p.m. Sundays in the second floor North Meeting Room. The unusual short film serves as an excellent introduction to Field Museum's new Hall of Jades.

Spring Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

March 4: **"Grecian Holiday,"** narrated by Ralph J. Franklin, looks at ancient ruins and modern cities.

March 11: **"Cambodia,"** narrated by Kenneth Armstrong, visits Angkor Wat, the capital of Phnom Penh, cities, and villages.

March 18: **"Trails of Tembo,"** narrated by Larry Linnard, travels to East Africa, land of the "big tusker," for wildlife scenes.

March 25: **"On the Trail of the Arctic Char,"** narrated by Karl H. Maslowski, searches for adventure in Canada's Far North.

Children's Program

Begins March 1

"Our Vanishing Wildlife," Spring Journey for Children, a free, self-guided tour focusing on animal species that face extinction, to help youngsters understand what is happening to them. All boys and girls who can read and write are welcome to participate in the activity. Journey sheets are available at Museum entrances. Through May 31.

Meetings

March 8: 7:30 p.m., Windy City Grotto, National Speleological Society.

March 9: 8 p.m., Chicago Mountaineering Club.

March 12: 2 p.m., Chicago Shell Club.

March 14: 8 p.m., Chicagoland Glider Council.

Coming in April

Spring Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

April 1: **"Southern Africa Safari,"** narrated by Cleveland P. Grant, travels to Transvaal, Rhodesia, and Mozambique.

April 8: **"Amazonas Hovercraft Expedition,"** narrated by David Smithers, adventure and exploration in South American waterways.

April 15: **"Enjoying the Out-of-Doors,"** narrated by Howard Orians, highlights nature's wonders.

April 22: **"Mexico's Californias,"** narrated by Ken Wolfgang, past, present, and future.

April 29: **"The Living Wilderness,"** narrated by Walter H. Berlet, animal life in the Rockies.

Volume 43, Number 4
April 1972

Field Museum of Natural History Bulletin

This issue of the *Field Museum of Natural History Bulletin* is entirely concerned with the discipline of botany, with special attention to the Museum's Department of Botany. Each of the other three disciplines represented in the Museum—geology, anthropology, and zoology—and the departments devoted to them will be similarly featured in subsequent issues of the *Bulletin*.

The issue is dedicated to Mr. John G. Searle. A recent action by our Board of Trustees designated the herbarium of the Museum as The John G. Searle Herbarium. This action honoring Mr. Searle was taken in recognition of his great interest in the Museum and strong support of the scientific program of Field Museum as a Trustee from 1952 until 1971, when he was elected a Life Trustee. The John G. Searle Herbarium, containing more than 2,500,000 plant specimens, is one of the great research collections of the world, serving scientists and students of all nations.

Field Museum of Natural History Bulletin

Volume 43, Number 4
April 1972

Cover design by Zbigniew Jastrzebski.

2 **Man and Plants**
Louis O. Williams

5 **People in Botany**
Johnnie L. Gentry, Jr.

8 **Wild Illinois**
Robert F. Betz

10 **The John G. Searle Herbarium**
Dorothy N. Gibson

12 **Collecting in Amazonian Peru: A Letter from the Field**
Donald R. Simpson

16 **The Flowers that Bloom in the Spring . . .**
William C. Burger

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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LOUIS O. WILLIAMS

MAN & PLANTS

Imagine, if you will, what America was like when it was first discovered by man—and here we do not refer to such late-comers as Leif Ericson or Columbus. Men out of Asia were certainly the variable genetic source of human populations in America. Over millennia they came to the northwestern extension of the North American continent, and then by agonizingly slow stages spread their kinds southward and eastward, eventually reaching and passing the equator.

Finally, and perhaps not long before the coming of Europeans to America, they reached the southern tip of what we now call South America.

How long ago did the first men come to America, and what was it like around that part of America where they first touched? Scholars do not agree about the point in time past when the first men came across the Bering Strait, but a convenient compromise figure might be 25,000 years ago. During the period of migration—which may have continued up to a thousand or so years ago, thus spanning a very long time as measured in men's life spans—the northwestern region of North America (as well as adjacent Asia) must have been a formidable place with a climate unbelievably harsh during many thousands of these years as glaciers waxed and waned.

The great Aztec market at Tlatelolco, A.D. 1515, exhibit in Hall 8, Field Museum.

Man certainly brought nothing with him out of Asia, except his dogs. Hunting and fishing must have sustained him until finally he came to milder climates, and somewhat drier ones. In front of him was a great vacuum as far as man was concerned, the only pressure was from behind. Time passed and new cultures developed—the earlier ones based on the grazing animals rather than those of the sea. Eventually a seed-gathering economy developed, and as man got farther south and into the tropics, where large animals were and still are scarce, his economy changed to one based on plants.

Man had now progressed far enough in space and time that we may begin to look for a higher culture than those based on nomadic hunting and seed-gathering.

Somewhere along the route of this southward progression men—or probably women—discovered, perhaps by accident, that the plants whose edible portions they gathered grew better on their middens and in the enriched soils around their dwellings than in the wild places that were the plants' normal habitats. This discovery of the cultivation of plants for food was, I think, the most momentous discovery of all time. Once the discovery was made, savagery was on the way out and the potential for civilization was present.

It is thought that about 8 square miles of land were required in a seed-gathering economy to sustain one man. On this basis the world could sustain a population of some 30 millions. The discovery of the usefulness and convenience of the cultivation of plants changed the whole outlook for man in America—and in the world, for that matter—and

permitted his uninhibited increase. When one man could produce food beyond the requirements of his family and have some left over for barter, someone else was freed from the never-ending daily chore of searching for food. Some men were then able to give thought to the betterment of their own condition and that of their fellow men.

Ancient high civilizations in America, as I conceive of them, developed in three regions: Mexico, Central America, and in the Andean region of northwestern South America.

What were the plants of America that were the basis for civilizations? I have called attention long ago to the coincidence that where ancient American civilizations were developed, there were plant foods that provided the essentials of a balanced diet. Basically, these plants could be as few as two: ideally the seeds of a grass, maize, which provided good and abundant carbohydrates; and the seeds of a plant that added protein to the diet, probably always a legume (bean family). Other kinds of plants added variety and vitamins—frosting to the cake if you wish—and we shall consider some of these in due course.

What were the (two) basic food plants upon which civilizations in America were developed and where did they come from? The answer to the first part of the question is easy—maize and beans—but to answer the second part is not so easy.

Maize and beans (there were two really superb kinds of beans) as we know them now, and as they were at the time of European discovery, were and are the results of thousands of years of selection. Essentially maize and beans are the creations of ancient men in America, men who were certainly not savages, and were not inferior in any way to European man at the time of discovery and the conquest—unless they were "inferior" in being less savage.

The origin of maize is still a controversial subject and one which was opened recently at a scientific meeting of the Society for Economic Botany here at the Museum. Dr. Hugh Iltis, of the University of Wisconsin, presented a paper, not yet published, in which he contended that corn is domesticated teosinte (*Euchlaena mexicana)* and differs from it not at all in any of its basic vegetative, floral, or genetic attributes. Dr. George Beadle has for the past three years been conducting tests of this hypothesis by means of large-scale experiments with hybrids of corn and teosinte. He will have an article about his work and conclusions in a future issue of the *Bulletin.* This concept is different from those previously published and one which must be considered. A small library has been written about maize, the world's most important cultivated plant, and the end is not yet!

Beans, the second component of a balanced diet, and one of the great civilizers, were and are abundant. Kidney beans or field beans *(Phaseolus vulgaris),* scarlet runner beans *(P. coccineus),* and lima beans *(P. limensis)* are the aristocrats of the beans of the world and they are all American.

The scarlet runner is, I think, to be found wild in Central America and it propagates itself without the intervention of man. I have seen wild beans in Central America that may be among the progenitors of the common kidney beans. The usual kidney beans are man's commensals and if left to their own devices will not persist. Lima beans are wild in much of tropical America, but the presumed wild progenitor differs much from the cultivated kinds, which, so far as I know, require man's help to persist.

These, like many another cultivated plant, have been selected for years, even millennia, by man to produce more or better food, and survival of the plant as a wildling was not a consideration in the selection.

A host of other food plants have been bequeathed to us by the early Americans. We have found no important food plants not known to people of pre-Columbian time. Potatoes, sweet potatoes, cassava, pumpkins and squashes, tomatoes, avocados—vegetables that we all know and that are to be found in our markets every day of the year—all originated here. Of these, the sweet potato is one of very few plants of economic importance that were cultivated in the tropics of both hemispheres before the beginning of recorded history.

Fruits of temperate regions were few in America and, with the possible exception of our native grapes, none is of very great importance. The old saying "as American as apple pie" is not really appropriate, because apples are Old World fruits. Let's change the expression to "as American as pumpkin pie," a traditional food for a traditional American holiday.

Except for pineapples, tropical fruits native to America are relatively little known in our markets. The grandest of all tropical fruits—citrus fruits, bananas, dates, figs, and the mango—are all from the Old World.

Plants important in our daily lives are not only those that provide food. A mere listing of the kinds of things that are derived from plants will bring to mind many that we use daily. There are fibers (cotton is the most familiar of them); forest products (wood, cork, the paper which you are holding); rubber and latex; gums and resins (the list of ingredients on your next can of soup may contain a gum); essential oils are in perfume; many kinds of oils and fats and waxes for literally thousands of food and industrial uses; sugars and starches; medicinal plants (a few, like quinine, of really great importance, but literally thousands have played a part in folk medicine from ages past down to today). Don't

forget the antibiotics, the miracle drugs of our day; and insecticides from plants, which cause little permanent damage to the biosphere. Then there are the fumitories and masticatories (like tobacco), many of which are under a cloud today; the narcotics—opium, pot (marijuana), and coca (cocaine), the only important narcotic of American origin. Among the spices everyone uses, the only important ones of American origin are the sweet and the hot (red) peppers.

Beverages which are made from plants include coffee and tea from the Old World; and cocoa and *maté* from America. Cocoa beans were used in Mexico from ancient times like currency, a measure of value in barter. The plants from which alcoholic beverages are made are multitudinous.

My colleagues in the Society for Economic Botany have raised the questions whether or not ornamental plants are economic or useful plants, and whether or not its journal should include articles on ornamentals. I feel that they are both economic plants and useful plants and that the world and the garden around your door would be a less interesting place without them. But then I am prejudiced, for the native orchids of the Americas have always been my special love.

Dr. Franz Schwanitz wrote in 1957 in his *Die Entstehung der Kulturpflanzen (Origin of Cultivated Plants)* that cultivated plants alone made it possible for 2.5 billion people to populate the globe. Fifteen years later, with probably well over 3.7 billion people populating the same globe, the major food source is still cultivated plants, but the supply is being strained in many parts of the world, even as it was in 1957. In the year 2000, the population of the world is projected to be some 6.4 billion persons. *If* the projection holds true, it will be due to much improved food plants and more efficient agriculture. Conversely, if the projection does not hold true, it could be because of insufficient food production from constantly shrinking land resources.

Last year a terrible storm blew out of the Bay of Bengal and innundated the fertile low-lying delta of the Bengal River. Perhaps as many as 500,000 people lost their lives in that disaster. It would seem that no man in his right senses would take his family to live on the Bengal River delta, for natural disasters are common events there. The fact is that man in that overpopulated portion of the world really has no choice. To grow the food to keep alive, he plays Russian roulette of necessity.

Although most plants that we use for food are ones that were selected or bred for special purposes by man long ago, some of the plant foods we collect or harvest have changed very little or not at all as the result of man's attention. The sap of the sugar maple is still collected and boiled down to make one of the prized delicacies of our larder. Wild, or Indian, rice, once an important food of North American Indians, is an expensive delicacy, now used for gourmet dishes and often as a special accompaniment to a Thanksgiving dinner. Wild raspberries and blackberries are still gathered—and both have given rise to cultivated forms which it is easy to trace back to the progenitor. Cranberries, another of the delicacies often used for Thanksgiving dinner, differ hardly at all from the wildlings that are still gathered. The fruits of the prickly pear cactus, called *tuna,* are gathered and to be found commonly in markets in Mexico and even now and again in Chicago. Algae from the sea are collected along the shores of much of the world either as food or industrial plants. The forest preserves around Chicago each spring and fall are invaded by connoisseur gatherers of wild native mushrooms.

Even today the gathering and breeding of wild plants to produce better useful plants is going on and will continue to go on. Two recent examples will suffice to indicate the trend. We owe the large and luscious blueberries that in recent years have become commonplace in our markets to the persistence of Dr. Frederick V. Colville, who took the native blueberry and through selection and breeding produced a plant which has become an important crop in America. We owe to the vision of Dr. B. Y. Morrison the glorious Glen Dale Azaleas, surely some of the finest ornamentals in a group of plants known for their beauty.

The United States Department of Agriculture has for many decades now had a broad program of exploration for and introduction of potentially useful plants. The program has been eminently successful over the years. A recent and on-going project is the screening of a vast number of plant species in the hope that components in some may be found useful for the treatment of cancer in man.

Look again at the useful plants around you, treasures from all the world. Can you imagine Italian cuisine without tomatoes? They were not in Europe before the time of Columbus. Brazilians think that their mangoes were always there—but they are Asian. Spring without tulips—can you imagine it? Tulips in endless variety are largely due to Dutch perfectionists.

We do classify plants in different ways for different purposes, such as "useful" versus "ornamental." One kind of classification I would not like to try to apply would be "necessary" versus "unnecessary." In one way or another almost any plant could be useful. And who would have the hubris to assert that plant X is quite unnecessary to the third planet from the sun, let alone to its human cargo?

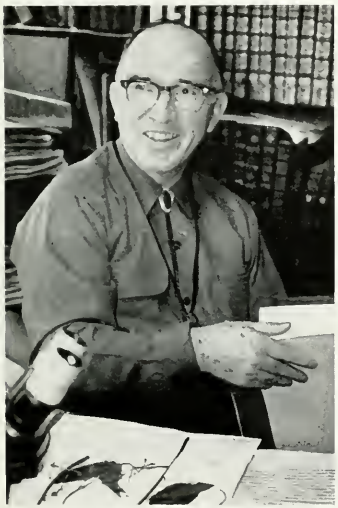
Dr. Louis O. Williams is chairman of the Department of Botany, Field Museum.

People in Botany

Johnnie L. Gentry, Jr.

The staff of Field's Museum's Department of Botany includes five curators, one visiting research curator, and eight subcuratorial members. The research activities are concerned mostly with floristic studies of the native plants of Central America and Amazonian Peru. This work is associated with the preparation of floras, descriptive inventories of the plants of these regions.

Dr. Louis Williams



Dr. Louis Williams, chairman of the department, has spent several years in the tropics studying plants, including eleven years as botanist and subdirector at the Escuela Agrícola Panamericana in Honduras. The early 1940s were spent searching for sources of secondary rubbers in central Brazil. Prior to coming to Field Museum he was botanist for the U.S. Department of Agriculture. His research project is to complete the *Flora of Guatemala,* a work which will comprise about fourteen volumes when finished. He is very interested in orchids and served as the editor of the *American Orchid Society Bulletin* for three years. He is presently a member of the Council of the Society for Economic Botany and is the Consul of Guatemala in Chicago. When not studying plants he can be found operating his printing press or bird-watching.

Dr. William Burger

The flora of Costa Rica project is the responsibility of Dr. William Burger, associate curator, vascular plants. Before joining the staff at Field Museum he spent four years teaching at the Agricultural College of Haile Selassie I University in Ethiopia. This is where he was impressed with the great need for research on tropical flora. Dr. Burger's main research interest is the study of the plants of Costa Rica, particularly the group that includes the peppers, oaks, and figs. His major avocation is photography and he is the current president of the Nature Camera Club of Chicago.

Dr. Patricio Ponce de León

Dr. Patricio Ponce de León, associate curator, cryptogamic botany, was born in Cuba. He was formerly curator in the botanical garden at Havana and professor of cryptogamic botany at the University of Havana. His research activities involve the group of fungi that includes the puffballs and earthstars. In addition to the fungi, he has responsibility for the Museum's collections of lichens, mosses, and algae.

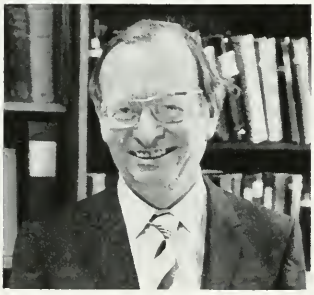
Dr. Donald Simpson

Dr. Donald Simpson, assistant curator, Peruvian botany, is presently conducting a botanical and forest survey in the Amazon basin of Peru. This research is especially valuable because it provides a scientific base for knowledge of the forest resources of Amazonian Peru. He is currently working on a synoptic flora of the Pachitea River area in Peru and is involved with the completion of the *Flora of Peru.*

Dr. Johnnie L. Gentry, Jr.

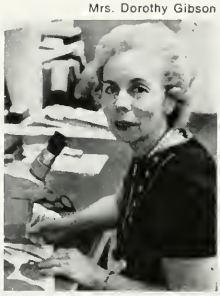
The newest member of the curatorial staff is Dr. Johnnie L. Gentry, Jr., assistant curator, vascular plants. His research is a part of the Central American projects being carried out in the department. The potato, or nightshade, family is being prepared for the *Flora of Guatemala* by him. Other research interests include the Borage family. He is active in community affairs, presently serving as the chairman of the Committee on Natural Resources and Environmental Improvement of the Willco Council of Governments.

Dr. Rolf Singer



Dr. Rolf Singer, visiting research curator in mycology, is one of the world's most outstanding mycologists. Prior to coming to Field Museum he spent almost twenty years in South America, first with the Instituto Miguel Lillo at the University of Tucumán, and then at the University of Buenos Aires in Argentina. It was during this time he traveled extensively and collected in areas not previously visited by mycologists. Dr. Singer recently returned from a year of study in Europe, where he was continuing work on the large group of fungi we commonly call mushrooms or toadstools (Agaricales). He now also teaches in the Department of Biological Sciences at the University of Illinois at Chicago Circle.

Mrs. Dorothy Gibson



Mrs. Dorothy Gibson, supervisor of The John G. Searle Herbarium, is an important member of the team working on the *Flora of Guatemala* and is making some major contributions to that project. She is presently working on a plant family familiar to horticulturists, the Gesners, one group of which are the gloxinias. Her interesting career before coming to the museum included owning and operating a country store in the backwoods of Kentucky.

Mr. John Millar

Mr. John Millar began his career at Field Museum in 1918 as a preparator of botanical exhibits. At various times he held the positions of curator of the Harris Extension, deputy director, and chief curator of botany, and is currently chief curator emeritus of botany. He continues to come in a few days each week to work on the economic botany collections. Mr. Millar directed the moving operations for the exhibits when the Museum moved from its old building in Jackson Park to its present home in Grant Park. The story that he had to resort to wearing roller skates in order to meet each moving gang at the elevator is true.

Mr. Ronald Liesner

Mr. Ronald Liesner, herbarium assistant, who left the dairy country of Wisconsin to go to the University of Wisconsin for a B.S. degree in botany, works mainly on the flora of Costa Rica project. He does much of the identification of Costa Rican plants and was field assistant on a recent expedition to Costa Rica. Nature photography is his favorite hobby.

Mr. Robert Stolze

Mr. Robert Stolze, custodian, fern herbarium, first came to the Department of Botany looking for part-time work to help finance his music studies. He soon took an interest in the ferns and pines and is presently responsible for our collections of these two major groups of plants. His research activities are currently centered around a group of tropical tree ferns. Recently he was elected treasurer of the American Fern Society.

Dr. Robert F. Betz, research associate

Miss Jane Lamlein

Miss Jane Lamlein, herbarium assistant, spends most of her time on the Peruvian projects. She is responsible for receiving and processing the collections, and for identifying a large part of them. For her B.A. degree from Miami University in Ohio, she majored in botany.

Mrs. Alfreida Rehling

The responsibilities of Mrs. Alfreida Rehling, herbarium assistant, include the important activities of processing requests for loans, exchanges of specimens, shipping and receiving of all specimens, and the correspondence that accompanies such operations. Maintaining our important collection of "type" photographs is also one of her responsibilities.

Mr. Almon F. Cooley, general assistant

Mrs. Roberta Carnagio

The administrative duties necessary for the overall support of the activities of the department are carried out by Mrs Roberta Carnagio, the departmental secretary, who also serves as the botany librarian.

Mrs. Karoline Benyovszky

The operation of mounting plant specimens for the herbarium has been handled by Mrs. Karoline Benyovszky for some ten years. She is now teaching the skill to Miss Kathy Henning, a recent addition to our staff, with whose help we will be able to reduce the backlog of unmounted material.

Miss Kathy Henning

Professor Antonio Molina R.

Professor Antonio Molina R., field associate, is botanist and curator of the herbarium at the Escuela Agrícola Panamericana in Honduras. At the present time he is an associate investigator in a field research program being carried on jointly by his institution and our Department of Botany. His valuable contribution to this project is represented by the numerous specimens he collects and sends to the Museum each year. He is probably the best botanical field man in Central America.

Miss Bertha Olguin, typist and general assistant

Photos by Fred Huysmans and Ed Jarecki

Dr. Johnnie L. Gentry, Jr. is assistant curator, vascular plants, in the Department of Botany, Field Museum.

WILD ILLINOIS

ROBERT F. BETZ

By thy rivers gently flowing,
Illinois, Illinois,
O'er thy prairies verdant growing,
Illinois, Illinois,
Comes an echo on the breeze,
Rustling through the leafy trees,
And its mellow tones are these,
Illinois, Illinois . . .

Though the first stanza of the Illinois state song depicts a land that is a veritable "Garden of Eden," an automobile drive through Illinois today is an uninspiring and rather depressing sight. Beyond straight ribbons of concrete, flanked by well-mowed shoulders, stretch countless fields of corn and soybeans. Except for a few patches of dandelion, chicory, or Queen Anne's lace, which are all foreign, there are few wild flowers of any kind. Native flowers are almost nonexistent. Here and there a line of scraggly trees and shrubs marks the boundary between one cornfield and the next. Occasionally a small overgrazed woodlot with widely spaced trees and grassy understory breaks the monotony of this landscape.

Very little wildlife is to be seen. With so few flowers from which to obtain food, bees and butterflies are scarce. Except for some house sparrows and pigeons around the farm houses, there are few birds. Rarely does one ever get a glimpse of a fox or raccoon.

The rivers that wind through this biological desert are dark and murky with the topsoil washed into them from the surrounding farmlands. Because of the herbicides and insecticides, many are almost devoid of any plant or animal life.

But it has not always been so. Before the hand of man desecrated the land, Illinois teemed with flowers and wildlife. The French explorers regarded it as one of the most beautiful places they had seen in North America. The prairies, carpeted with grasses and flowers, studded with island groves, and enveloped by strips of river

timber, never failed to elicit the admiration of Europeans seeing them for the first time. Often they compared the prairies and forest groves to an ocean with its shores, for to many the outline of a distant forest appeared like a dim shoreline with capes, inlets, and points of timber jutting out into this "sea of grass."

The virgin Illinois landscape must have been an unforgettable sight. In the spring of the year the prairies were strewn with golden Alexanders, pink shooting stars, and purple phlox and the edges of the forest groves filled with the pink and white blossoms of the redbud, dogwood, and wild cherries. In autumn the tall waving

A patch of virgin prairie in northern Illinois with big bluestem grass, wild quinine, and prairie gayfeathers.

expanse of big bluestem grass was flecked with asters, goldenrods, and gentians.

The northern two-thirds of Illinois was mostly prairie surrounding isolated groves, while the southern one-third was principally forest enclosing patches of prairie. Many of the groves were given names—some for the predominant tree they contained, such as Bur Oak Grove or Maple Grove; others for a settler who homesteaded along the edge of the grove, such as Downer's Grove or Walker's Grove. Many of the prairies also had names, such as Looking-glass Prairie or Hawkins' Prairie. The largest prairie in the state was the Grand Prairie in east-central Illinois, where a man could travel for hours without ever seeing a clump of trees.

The prairies and the forests were alive with animals. Out in the open one could hear the booming of the prairie chickens and the clear flute-like calls of soaring upland plovers, or see the strange courtship display of the sand-hill cranes. Small herds of bison, elk, and white-tailed deer could be seen grazing. In the woods there were wolves, coyotes, black bears, mountain lions, bobcats, and many others. Around the marshes large flocks of whistling swans, geese, ducks, and other water birds congregated. In springtime the groves rang with the sound of hundreds of thousands of warblers, vireos, and sparrows moving north to their breeding grounds in Canada, while in the river timber there were flocks of chattering Carolina paroquets and pairs of bald eagles. At times migrating flocks of passenger pigeons moving from grove to grove darkened the sky.

Most of the streams and rivers ran clear over gravelly bottoms, and from the shores schools of suckers, chubs, and shiners could be seen moving upstream to spawn. In clumps of eelgrass or under lily pads northern pike and different kinds of bass and sunfish lurked. The deep croaking of bullfrogs resounded along the shore. Turtles of all kinds sunned themselves on protruding rocks.

This beautiful and unpolluted Illinois that the French explorers knew and the Peoria and Kickapoo Indians hunted on has just about disappeared. Only a few small patches of the original landscape persist, along certain railroad rights-of-way, in sanctuaries, or in some old settler cemeteries—with white prairie clovers, yellow coreopsis, and purple gay feathers. Virgin forest, where white trilliums, yellow violets, and purple orchids herald spring, still survives only in the recesses of a few forest preserves or in isolated draws that are protected from the ever-increasing populations of man and his domestic animals. And even these pitifully small remnants are being destroyed.

If for no other reason than to provide us with places to go for peace and solitude, these remnants of wild Illinois should be preserved and cherished.

Dr. Robert F. Betz is professor of biology, Northeastern Illinois University; consultant to Illinois Nature Preserves Commission; and research associate, Department of Botany, Field Museum.

The John G. Searle Herbarium

Dorothy N. Gibson

In a herbarium, a rose, by any name whatever, doesn't smell at all—except perhaps of the chemical insect deterrents necessary to protect and preserve it. That is because a herbarium is a collection of dried plants, preserved not for their beauty or fragrance or souvenir value, but for their value as records. Once a plant specimen is mounted on a sheet of paper, labeled with such information as place and date collected, habitat, flower color, etc., and identified, it becomes much more than a dead plant. It is a record and a symbol of a living organism connected with the fossil past and with the evolving future.

These plant collections can then tell us many kinds of things. They tell us about plant migrations over the ages, sometimes from one part of the world to another. They tell us about environmental conditions and how they have changed and may be changing now. They can be used as indicators in land-use surveys to guide men's judgments so that human purposes can be compatible with natural conditions. Plants are, after all, the basis of human economy. We put them to numerous uses, as in farming, forestry, range management, or for medicines or other chemical compounds.

Our herbarium, established in 1894, and named this year in honor of Mr. John G. Searle, longtime friend and Trustee of Field Museum, is actually three herbaria. There are three distinct collections—one of seed plants, one of ferns, and one of lower plants (fungi, lichens, liverworts, mosses, algae, and bacteria). Altogether, there are more than 2,500,000 specimens, about three-fourths collected in the area from Mexico to Argentina, including the West Indies. There are also separate collections of seeds (in vials) and of pollen samples (on glass slides).

The first plant specimens deposited in Field Museum's herbarium were collected by Dr. Charles F. Millspaugh in the Yucatan Peninsula, 1894-96. His collections from the West Indies during 1898-1907 added more than 5,000 plants. Curators in the Museum's Department of Botany in the early years, realizing that very little botanical collecting had been done in the American tropics, concentrated their efforts on these regions, and staff members since then have continued collecting in this area.

One of the world's major collections of Central and South American plants, many from habitats that no longer exist, are here in Field Museum. Anyone who wishes to study the flora of these regions could hardly do a thorough job without using our herbarium. Besides the large tropical collections, our herbarium contains a good representation of plants from other regions of the world, and is especially fortunate to have good early collections from the midwestern states, including the Chicago region.

The herbarium acquires plant collections in several ways. Plants may be purchased, received as gifts, received in exchange with other institutions, or collected by botanists on Museum expeditions. During the past 75 years we have been exchanging duplicate plant specimens with 85 museums in 36 foreign countries and with 90 museums, universities, and individuals in the United States.

The oldest specimen now stored here is a plant collected in 1772 by J. R. and G. Forster, botanists who sailed with Captain Cook on his second voyage in Tahiti. It was received in exchange from the British Museum of Natural History, as were a few plants collected in 1792 by James Wilkes and Christopher Smith, who accompanied Captain Bligh on his second voyage to Polynesia (the mutiny did not adversely affect his continuing career). Other early collections obtained in exchange include several hundred duplicate plants from the Madrid herbarium, collected in Mexico between 1788 and 1804 by Sessé and Mociño, Castillo and Maldonado, under the patronage of King Charles III of Spain.

Field Museum has sponsored or co-sponsored more than 60 botanical expeditions to the American tropics, which have added many thousands of specimens to our herbarium and allowed duplicates to be deposited in most of the world's major herbaria.

When specimens are collected in the field they are cut to fit between the pages of a tabloid size newspaper. They are then flattened in a press and dried. If heat is not available for immediate drying, then formaldehyde diluted with water is applied to prevent molding and the moist plant material is packed in waterproof material until it can eventually be dried. The specimen is given a field number and all appropriate information about it is recorded in the field book. (A specimen without locality and field data is almost worthless.) When the specimens reach the herbarium they and their labels are mounted with glue or plastic compound on sheets of high quality paper about 11½ X 16 inches and a little thicker than a magazine cover. Groups of sheets are stored in strong manila folders inside steel cases with airtight doors.

Maintenance is a never-ending chore, requiring continuous scrutiny of specimens and regular periodic decontamination procedures. Plant specimens might last as long as the pyramids, or at least as long as the paper on which they are mounted, if they are properly protected from insects, fire, and dampness.

In recent years, the herbarium collections have been growing at the rate of about 20,000 specimens per year. This figure does not include the numerous duplicates which are sent out in exchange to other large herbaria.

It may seem to the non-botanist that by now there should be enough plant specimens in storage in herbaria around the world so that no more need to be collected and housed—or, at least, collecting efforts can slow down. But this is not true. It is true that most

of the earth's regions are now fairly well "known" in the sense that they were long ago visited, mapped, named, revisited, and in some cases even televised. But most regions of the earth have *not* yet been completely explored for plants. In fact, some of the regions "known" for the longest period of time may be the least known botanically. There are large areas of vegetation viewed daily by air travelers which nevertheless remain unexplored by plant collectors. They contain plants that are living, multiplying, changing, developing—which we must continue to collect, identify, and preserve for study as indispensable records of generations of plant life. Only by such studies can we continue to learn about the variability of species, the numerous uses of the plants, what geographic areas each species extends over, and how that area may be expanding or receding.

Mounting a specimen for the herbarium.

Evolutionary change is usually such a slow process that many samples of the forms it produces must be captured as cross-sections out of both time, as it flows along, and place, as environmental conditions change. That is the only way we can achieve full understanding of the nature and directions of the changes and the forces that influence them.

The accumulation of these plant "records" in a herbarium represents an accumulation of specialized knowledge. New species of plants are based on them. If after the botanist has compared a plant with other similar ones stored in his herbarium and in other large herbaria, the plant remains unidentified, it may represent discovery of a species new to science. It is named, a description is published in a scientific journal, and this plant is then considered the "type" specimen, or evidence, of the new species, and it must be kept available for examination in years to come.

The sometimes long Latin names of plants may look unnecessarily complicated to a non-scientist, but they actually represent a neatly simple classification system. Since 1753, when the Swedish botanist Carl von Linné perfected the system of binomial nomenclature, plants have been given two-part names. The first part represents the genus; the second identifies the particular species. The same plant growing in three different parts of the world may have three different common names. Conversely, one common name may be applied to several different plants. Regardless of the numerous common names applied to a single species, botanists and horticulturists around the world understand which plant is referred to when the Latin binomial is used. For instance, the widely distributed weed *Chenopodium album* is called both "pigweed" and "goose-foot" in our northern states. In some southern states it is known as "careless weed." In Canada it becomes "anserine," and in Cuba, "apasote." The Linnean system of nomenclature, now internationally used, prevents misunderstanding.

In addition to numerous actual type specimens deposited here, our herbarium has on file more than 53,000 photographic negatives of type specimens of Central and South American plants. Over 40,000 of these are of specimens deposited in the large European herbaria. This enormous photographing project, done by Mr. J. F. Macbride between 1929 and 1937, financed in part by the Museum and in part by the Rockefeller Foundation, has proved to be far more important than its planners realized. During the bombings of World War II specimens housed in the Berlin herbarium were destroyed, and so Field Museum's photographic negatives are now the only evidence of those extremely important plant records.

Since Field Museum's herbarium was established, its plant records have been in constant use by botanists, students, teachers, gardeners, pathologists, medical researchers, chemists, geographers, ecologists, and even customs inspectors and criminologists—from nearly every major educational institution in this country and from more than two-thirds of the other countries of the world. And it is, of course, used daily by Museum staff members. Specimens are also made available to others for study in the form of loans. In 1971 alone, more than 11,000 specimens were sent on loan to other institutions.

The herbaria of the world contain the only records of man's knowledge of the vegetation of the earth. Field Museum's newly named John G. Searle Herbarium is one of the most important of these. The value of these plant records increases each year.

Dorothy N. Gibson is supervisor of The John G. Searle Herbarium of Field Museum.

Collecting in Amazonian Peru: A Letter from the Field

Donald R. Simpson

Pucallpa, Peru
March, 1972

There had been sunny skies for two days, rare at this time of year, so I decided to make a special side trip to see if I could solve some puzzles that I encountered while identifying a group of rubiads about a year ago. Rubiad is a kind of nickname commonly used by botanists to refer to plants belonging to the family Rubiaceae, a very large assemblage of species that includes such things as coffee, gardenias, and the quinine-yielding cinchona tree. A good story should have an interest-catching beginning, and fortunately I don't have to invent one, for this story has its own.

The beginning was amidst the pomp and grandeur of Europe in the eighteenth century, what the historians aptly call the Age of Enlightenment. Only I really can't recount for you more than the barest essentials, otherwise I would never get around to telling what happened on this two-day journey. Fortunately someone else has already written about that earlier period in a book titled *Flowers for the King,* and I must say that the book's author has done a much finer job than ever I could. But to get on with the story, the eighteenth century in Europe was a time when royalty and nobility took a great interest in the new fields of science and natural history.

At that time Charles III, King of Spain and Emperor of the Holy Roman Empire, though ruler over more territory than any other sovereign, thought his court was rather provincial. While other princes had sent out expeditions to various parts of the world to bring back curiosities to fill their "natural history cabinets," and in so doing considerably advanced the sciences of biology and geology, Spanish sovereigns had been content to ignore such pursuits. It was apparent to Charles III that his court had in this respect fallen behind the fashions of the day. To correct this oversight he ordered three grand expeditions to be sent to the three viceroyalties into which his lands in the Americas were then divided. These expeditions were instructed to inventory the natural resources, especially the vegetable and mineral resources of those regions.

The expedition to the Viceroyalty of Peru was entrusted to two very capable botanists, Hipolito Ruíz and José Pavón, who were accompanied by the French botanist and geologist Msr. Dombey, plus a host of assistants, including artists to make color illustrations of the plants, minerals, and animals. Ruíz and Pavón spent several years in Peru and Chile making extensive collections throughout those areas that were accessible to them.

Only in one area of Peru were they able to get down into the rich Amazonian forest, and then they were able to penetrate only into the edge, the region now called *Ceja de la Montaña* (Eyebrow of the Mountains). From that region they brought back and described a great abundance of species of plants new to science.

Among these "novelties" were a great many rubiads, for they had explicit instructions to make a special study of the quinine-yielding cinchona tree and its relatives. Quinine bark was the most important export from this forest region, bringing fabulous prices on the world market and a considerable revenue to the Spanish government. Thus it was that when they returned to Madrid they took with them extensive collections of dried plant specimens from the *Ceja* region.

In the two hundred years since Ruíz and Pavón entered the Amazonian forest, numerous other botanists have traveled through the same area collecting plant specimens for scientific study, some collectors even retracing part of the route of the royal expedition. Despite that, to this day many of the new species described by Ruíz and Pavón have not been encountered again and are known only from the dried specimens they took back to the Royal Botanic Garden in Madrid. I became aware of this just about a year ago and was quite puzzled about the reason. Are those species now extinct in that area? Are they still there but have just been missed by other botanists? This seemed unlikely because Professor Poeppig, the very meticulous German botanist, had retraced part of the route taken by Ruíz and Pavón, making careful collections when on his long expedition of the 1840s. A third possibility came to mind that some of those Ruíz and Pavón species were really just random mutants of some common species, what the horticulturist calls "sports." This last possibility seemed unlikely also because from other evidence we know that Ruíz and Pavón were very accomplished scientists, keen observers, and unlikely to have been misled into calling a wild mutant plant a new species.

That left the first hypothesis seeming to be the most likely—until I remembered one other thing. The year before, I had made a trip by car from Tingo María to Huanuco and back, looking for some plants belonging to the gloxinia family, and our road had taken us through the area of the *Ceja* where Ruíz and Pavón had spent so much time. I distinctly remember passing through areas of forest, some of which appeared to be still virgin woodland as Ruíz and Pavón described them. Well, there is only one way to solve those puzzles, and that is to go over that road again and make a careful search in the remaining parcels of forest for these "lost" species.

Fortunately I had a few more days before having to go to Aguaytia out on the flatlands of the Amazon Basin. I mentioned my intention to some of the biologists at the local agricultural university and learned that the entomologist was anxious to search for certain types of beetles in that same area. Pooling our resources, we hired a car and driver and, joined by Mr. Schunke, the field botanist who works

Cordillera Azul between Tingo María and Pucallpa, Peru.

for our Amazonian forests inventory project, we set out on Sunday for Huanuco.

Located in a rather dry part of the Upper Valley of the Huallaga River, about 6,500 feet above sea level, Huanuco is the departmental capital (a department is more or less equivalent to a state) and dates back to colonial times. The road between Tingo María and Huanuco, formerly a narrow single lane that was often impassable in the wet season, has recently been widened, and, though unpaved, has an all-weather gravel surface. When Ruiz and Pavón traveled here two centuries ago there was only a trail which they traveled by mule train. Where the going was especially steep and slick they were forced to dismount and travel on foot.

We stayed overnight in Huanuco and enjoyed breakfast in its ideal morning temperature before making the return trip on Monday, over the same road. The 6,500-foot elevation here gives night temperatures that are cool but not chilly, while the days are warm and dry. The highway on leaving Huanuco leads down the Huallaga River for a way, then climbs to the 9,100-foot-high Carpish Pass, dropping on the other side to eventually enter the Middle Valley of the Huallaga River, where it passes through Tingo María, which sits at about 2,000 feet.

At about 9,000 feet we stopped and entered the forest on foot. The trees here are small though mature, the branches covered with heavy growths of mosses, lichens, and numerous larger epiphytes. The undergrowth is a nearly impenetrable tangle of shrubs, vines, and hardy species of bamboo grass (*Chusquea* sp.). We followed paths already cut into the dense undergrowth, but to reach a plant in bloom only a few yards off the path we had to clear every foot of the way with machetes. We were rewarded with an important "find," a blue-flowered shrub with only one cluster of flowers

remaining, all the others having already set fruit and dropped their blue corollas. I was excited; this may be one of the "lost" rubiad species. Ruíz and Pavón collected a great number of plants in this region that were new to science. Most of them are now fairly well known to present-day botanists, but there were a few which have not been encountered again by botanists and which I refer to as "lost."

Later, back in Tingo María I checked my notes and found this is indeed a Ruíz and Pavón species, but it is not one of the "lost" species. Neither is it one of the well known ones. It seems that our blue-flowered plant has been seen only twice in the 200 years since the royal expedition so it will be a valuable addition to Field Museum's collections. Its value, though, is not so much in its rarity but because it may, on examination in the laboratory, provide some answers to some botanical riddles concerning this species and certain of its allies. I shan't attempt to recount at this time the nature of these scientific riddles, for they are rather complicated.

The temperature dropped a bit as low clouds moving in from the northeast blotted out the sun. We returned to the car to put on sweaters and jackets and to drive on through the tunnel built under the crest of the pass.

We continued on down the mountainside for about six miles to where the forest, still a cloud forest, is taller and, we soon learned, much richer in number of different species it contains.

We parked along the roadside and entered the forest on a spur of the mountainside that juts out from the road then drops away precipitously. My associate stopped to join the entomologist in tearing apart some rotting logs in search of wood beetles, so I proceeded along a trail that climbed a short distance then descended again. The trail ended abruptly where a small tree that had been chopped down had fallen about five yards down a precipitous slope, thus creating an opening with a magnificent view of the canyon and mountains.

As I stood there enjoying the view a blob of red caught my eye to the left. It was an epiphytic shrub in bloom hanging from one of the larger trees. With binoculars I saw that it was an ericad, of which there are a great variety of species (they belong to the Rhododendron family). I am collecting them for special study. This one was different from the ericads we collected the previous afternoon at the summit. Those were all terrestrial species—that is, they normally grow in soil—and where you find one you usually can find several others of the same kind nearby. This was one of a group of species that occur only as epiphytes in trees, and usually as widely scattered individuals.

Many epiphytes are notoriously difficult to find and even more difficult to collect because to the collector at ground level anything sitting up on the crown of a tree is usually obscured by intervening lianas, shrubs, and lower trees. And when found, often the only way to collect them requires cutting down the whole tree—usually a great deal of chopping just to get at one small epiphyte. It is little wonder that these epiphytic ericads are rarely collected. To add to the complications, they won't grow in just any forest; they are almost exclusively in mature trees in virgin forest. This was the first time I had ever seen one outside a museum laboratory!

I soon saw that it was on a limb that jutted out over a cliff that dropped away some fifty feet, and the limb wasn't the type one could climb out onto safely. My associate, the field botanist, had in the meantime left the entomologist to his beetles and joined me on the trail. He immediately set to work looking for the right size limb. He selected one and with a few whacks of the machete had a seven-foot pole with a Y branch at the tip. He hooked the Y against a branch of the flowering ericad, twisted several turns, then pulled. The branch snapped and we soon had one specimen in our hands. But we needed more flowering branches, so he tried for a larger stem. It broke off, but landed over near the fallen tree trunk beyond the end of the trail, some five yards below where I was standing. It was apparent that no more of the ericad could be reached with the Y pole, so I set about finding a way down to retrieve the branch lying below. By working around the other side of a hillock I was able to reach the fallen tree. Stepping out on this and hanging onto any available stump, vine, and branch, I retrieved the ericad.

Then I happened to look down. For some reason I had assumed that the fallen tree was lying on an inclined slope of the mountainside, securely braced against other shrubs and trees. It was being held up by woody branches, but when I looked down there was no hillside below, just branches, air, branches, and more thin air. I could see a tree top 25 yards directly below where I had just stood balanced on one foot, one hand on an unimpressive sized branchlet, stretching as far as I could to reach the ericad. I have all my life had acrophobia, especially where the surface drops away vertically, such as at the window of a skyscraper.

I regained solid ground and rested to let my heart stop pounding and my nerves recuperate. By this time Mr. Schunke was calling me to look at a rubiad he had just found. It seems that while poling for the ericad he had been standing next to a shrubby rubiad he recognized as belonging to the group we were searching for earlier. It was a species belonging to the genus *Psychotria.* Further examination later suggested that it very probably is one of the "lost" rubiads,

The undetermined species of epiphytic ericad that I nearly fell into the abyss to get. Photos by the author.

unseen since the Ruíz and Pavón expedition!

We had just turned to take the collected materials back to the car when Mr. Schunke discovered another shrubby rubiad, which I immediately recognized as another species of *Psychotria* belonging to a different and very distinctive section of the genus, but I couldn't recall any species that has the appearance of this specimen. Even after checking my notes I'm still unable to decide. Is it something previously unknown in this part of South America, or possibly something previously unknown to science? I won't be able to answer these questions until I have a chance to study the specimen in the laboratory at Field Museum and compare it with our extensive herbarium holdings. They include 200-year-old specimens collected by Ruíz and Pavón on this mountainside, which we obtained in the early 1950s from the Royal Botanical Garden Herbarium in Madrid.

We traveled on, stopping once more near where the Chinchauito enters the Huallaga River to make one more search for ericads and rubiads. No luck here, but it was getting dark so we returned to the car and resumed our journey. At the juncture with the Huallaga River we left the trail of Ruiz and Pavón. They turned upstream and stopped at the village of Cochero, spending quite a long time there collecting in the rich forests that surrounded the village. Neither the village nor the forests exist today; this whole mountainside is now open grassland.

Our road turned left to follow the Huallaga downstream along a canyon whose slopes have mostly been planted in coffee bushes shaded by low, spreading "shimbillo" trees. About fifteen minutes later the canyon broadened to a small valley that contains the village of La Palma, then closed in again. The highway is perched on a ledge between the river and the forested slopes. A few minutes later the canyon ended and on our right was the little agricultural university, and beyond it the town of Tingo María.

The journey was very successful. One conclusion I have reached as a result of our finds is that the "lost" species are probably all there to be found, but in the dense tangle of those cloud forests of the *Ceja* it may require luck as well as diligent searching to find all of them again.

Dr. Donald R. Simpson is assistant curator, Peruvian botany, in the Department of Botany, Field Museum.

The flowers that bloom in the spring...

william c. burger

Trilliums, anemones, spring-beauties, and violets carpeting the forest floor—these and many more are part of nature's yearly spectacle of spring flowering. After a long cold winter these delicate blossoms announce the resurgence of life.

This sudden burst of flowering is familiar to many people but few ask why so many flowers bloom at this time. Return to the woodland in summer and you will find precious few flowers on the dark forest floor. By fall the asters and goldenrods are blooming, but their numbers are mostly in open fields and pasture.

To understand the phenomenon of spring flowering we should observe a native prairie. Here, surprisingly, springtime does not produce a dramatic floral display. But if we return to the prairie in summer, we will find a continuing pageant of flowers that continues into the early fall. The difference in flowering tempo of forest and prairie gives us a clue to why our spring woodlands offer such a spectacle.

If we examine the forest floor in summer, under a canopy of leaves, we find few of the little plants that bore the blooms of spring. Most completed their life cycle in that brief period between the time of killing frosts and the time when the trees have fully expanded their leaves. Only during this

period do these plants have access to the warmer temperatures and energy-giving sunlight necessary for them to carry on their life processes fully. In summer the leafy canopy of the forest intercepts the sunshine—that is why so many of these smaller plants must live their lives quickly in spring. The plants of the prairie have no such canopy spread over them. The radiant sun is theirs throughout the summer and they can pace their lives accordingly.

The forest of trees whose broad leaves are shed each winter and replaced each spring is our setting for the pageantry of spring flowering. Nature provides similar displays in other settings too, for different reasons. Desert areas after seasonally heavy rains can produce a landscape covered with flowers. A desert "springtime" is dependent on rain that is none too reliable, and often there are years with little or no flowering. Another of nature's settings in which spring flowering is both predictable and spectacular is found in those areas with a Mediterranean climate. The Mediterranean area has a dry hot summer and fall, a winter that is cool and wet, and a spring that brings warmer weather and the end of the rains. Summer and fall are too dry for growth and flowering, while winter is too cold. Under these conditions plants have little choice, and almost everything that blooms can be found blooming in springtime.

Some of the flowers most characteristic of our early spring gardens came from the Mediterranean region. The crocus, tulip, hyacinth, and daffodil all come to us from that part of the world. Like many of the plants of our forest, they flower quickly by storing food in underground bulbs, roots, or other organs. The embryonic flowers and the food energy necessary for rapid growth were developed in the previous year. This explains how these plants can grow and flower so quickly.

A number of areas in the world have a Mediterranean climate and are famous for their wild flowers. Of these, South Africa and western Australia have the richest diversity. In western Australia during late September and early October (their springtime down under) you can go on bus tours devoted entirely to seeing the wild flowers. I believe there are no other tours like these in the world—seeing wild flowers for seven days. That's right—

there are so many wild flowers of so many kinds that these bus tours need a whole week to sample the variety. But the display doesn't last long. Soon the weather is hot and dry, the vegetation is withered, and tour buses head for the sea shore.

Dr. William C. Burger is associate curator, vascular plants, in the Department of Botany, Field Museum.

CALENDAR

Exhibits

Continuing

Australian Aboriginal Art from Arnhem Land, a selection of nearly 400 bark paintings and some wooden ceremonial sculptures. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit exploring the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through September 4. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical

Hours

9 a.m. to 5 p.m. Saturday through Thursday
9 a.m. to 9 p.m. Friday

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

and living world and how it functions in plants and animals. Continues indefinitely, Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. Continues indefinitely.

Morton Arboretum: 50th Anniversary, a small commemorative exhibit, featured in the South Lounge through June 4.

Free Film Program

Spring Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

April 1: **"Southern Africa Safari,"** narrated by Cleveland P. Grant, travels to Transvaal, Rhodesia, and Mozambique.

April 8: **"Amazonas Hovercraft Expedition,"** narrated by David Smithers, adventure and exploration in South American waterways.

April 15: **"Enjoying the Out-of-Doors,"** narrated by Howard Orians, highlights nature's wonders.

April 22. **"Mexico's Californias,"** narrated by Ken Wolfgang, past, present and future.

April 29: **"The Living Wilderness,"** narrated by Walter H. Berlet, animal life in the Rockies.

Continuing

"Patterns for Survival" (A Study of Mimicry) presented at 1:30 p.m. and 3 p.m. on Sundays in the second floor North Meeting Room.

"Chinese Jade Carving," shown at 2 p.m. and 3:30 p.m. Sundays in the second floor North Meeting Room.

Children's Program

Free Spring Film Series Saturdays at 10:30 a.m. in the James Simpson Theatre.

April 8: **"Dinosaurs: The Terrible Lizards."**

April 15: **Camp Fire Girls Day: "American Indians."**

April 22: **Cub Scout Day: "Circus."**

April 29: **Museum Traveler Day,** with presentation of Journey awards: **"Darwin the Naturalist."**

Continuing

"Our Vanishing Wildlife," Spring Journey for Children, a free, self-guided tour focusing on animal species that face extinction, to help youngsters understand what is happening to them. Through May 31.

FIELD MUSEUM'S MEMBERS' NIGHTS

"AN OPEN DOOR TO THE WORLD"

MAY 4 and 5, 1972

6:00 to 10:00 p.m.

Look above and beyond Field Museum's famous elephants. Get acquainted with the many activities that go on behind the scenes. Visit the scientific departments and see current research projects, demonstrations, and displays. Meet staff members. Come for an evening of fun and entertainment. Here are some highlights.

Department of Anthropology—recently collected ethnographic material from New Ireland; display of oriental weaponry; specimens renovated by conservation laboratory.

Department of Botany—The Searle Herbarium; collecting, pressing, and mounting plant specimens, display: "A Plurality of Singular Plants."

Department of Geology—display: "History of the Earth"; display. "Exploration of Continental Drift"; demonstration: Washakie Basin *Titanothere* Quarry.

Department of Zoology—display of illustrations for *Manual of Neotropical Birds;* "Monkey Business" (a book in the making); display. "An Electric Adventure with Cichlid Fishes."

Department of Exhibition—artistic skills used in the Museum: from sculpture, to model-making, to taxidermy, to scientific illustration, to graphics, to design.

Don't miss these special offerings—"Botanicasa," a shop featuring herbs, foods, and cosmetics; a "mini-tour" for youngsters, with a surprise memento at the finish line; a slide lecture presentation and a film on current exhibits; a live program in Stanley Field Hall; refreshments.

Volume 43, Number 5
May 1972

Field Museum of Natural History Bulletin

METEORITES: GEOLOGY OF SPACE

Each day about 70 million objects from outer space impact the Earth's atmosphere. On the average only one or two make it through to the surface before burning away completely by friction with the air. Of these, two-thirds fall into the oceans, because the earth is covered by that much water. The result is about 165 that might actually be recovered each year, though most of these are too small to be noticed, or fall in areas of low population where they succumb to weathering and crumble away before they are found. In all the recorded history of mankind, fewer than 2,000 of these have ever been recovered. Together they comprise the study objects of one of the branches of space sciences, meteoritics.

Meteoritics, the study of meteorites, has become important only in the last twenty years. Before that it received only intermittent attention by a few men, who are now (of course) called "pioneers." One of these, Oliver C. Farrington, was the first curator in this Museum's Department of Geology. In fact, for many years he was the Department of Geology. How he first became interested in meteorites is not known. He showed remarkable foresight, for in his day meteorites were regarded with little interest. He gradually brought together a collection of meteorite specimens that grew to be one of the largest and most important collections in the world, a position it has held ever since.

With the advent of space programs, research in meteorites has increased enormously, the research output doubling about every six years. Interest in them has still not abated even though samples have been returned from the moon. Our moon is a single extraterrestrial object in the same relative place in space as the Earth and sharing with the Earth a certain common heritage. Meteorites, on the other hand, are derived from a number of planetary objects (some possibly from comets) from varied locations in space. They are objects that have suffered little change since the early history of the solar system, in contrast to the Earth, which has been altered considerably from its primitive condition.

Bit by bit meteorite research has yielded clearer views on the formation of solid planetary objects and their chemical and physical evolution. We are able to see features of the very earliest stages, when a glowing hot gas first cooled enough for small solid specks of mineral dust to form. As the gas cooled, more and more solid specks formed, coalescing ultimately into the planets of the solar system and the thousands of small asteroids and comets associated with them. We see in meteorites the results of over four and one-half billion years of exposure to cosmic rays and radioactivity. We see the gradual appearance of chemical compounds of increasing complexity, some of them the fundamental chemicals for the creation of living things. We see in them the sequence of events that shaped the Earth into the layers from which grew the continents as we know them.

Though many questions have been answered by the study of meteorites, other puzzling, unanswered questions have appeared in the process. What are the tiny (about 1/25 of an inch) spherical mineral beads that are found in so many meteorites? They were among the first things noticed by meteorite investigators a century ago. They called them "chondrules," from the Greek word *chondros*, meaning "grain of seed." They are made of spherical aggregates of minerals, all of which are well known in terrestrial rocks; but in terrestrial rocks these same minerals never occur in these peculiar spherical beads. Meteorite workers have puzzled over these for 100 years and today are no closer to knowing how and why they formed during the early stages of our solar system. Did the Earth once consist of a cluster of billions of them, or are they the product of some early planetary volcanic process? Today they hold their secrets as they have since they were first noticed. Their presence is a nagging reminder to researchers that we do not yet know everything—and a certain amount of humility is required of even the most self-assured among us.

The cover of this issue of the *Bulletin* utilizes a characteristic cross-section of one of the tiny chondrules from the meteorite Alfianello, which fell near the village of that name in Italy in 1883. Its unique symmetrical pattern of mineral grains is difficult to explain. But as a primitive bead of primordial solid matter of our solar system, this chondrule is a symbol for the growth of planets and the study of them—geology.—***by Dr. Edward J. Olsen, curator of mineralogy, Department of Geology, Field Museum.***

Field Museum of Natural History Bulletin

Volume 43, Number 5
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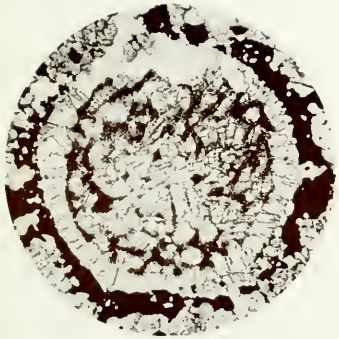

Cover design by Don Skinner, based on above photographic magnification of a chondrule from Alfianello meteorite; actual chondrule measures 1/25 of an inch across.

Meteorites: Geology of Space
Edward J. Olsen
these identified flying objects from outer space reveal much concerning the earliest stages of solid matter, but some things about them are still a mystery

2 **Mountain Building and the Theory of Global Plate Tectonics**
Bertram G. Woodland
our knowledge of the evolution of Earth's crust has been a collection of jigsaw puzzle pieces; they are now being put together into a coherent picture

6 **The Early History of the Geology Department**
Eugene S. Richardson, Jr.
about Farrington, Nichols, Riggs, and Roy, four to remember, four to enjoy

9 **"The Mile-Wide Mutterings of Unimagined Rivers"**
John Clark
unexplored rivers that flowed millions of years ago can tell us as much as rivers that can get us wet

10 **The Rest of the Iceberg**
Katherine Krueger
exhibits display only a tiny fraction of our geological and paleontological collection; the vast bulk submerged from public view are explained

14 **Who's Who in Geology**
Patricia M. Williams
the seven scientists and six assistants who do the work

Calendar

Field Museum of Natural History
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Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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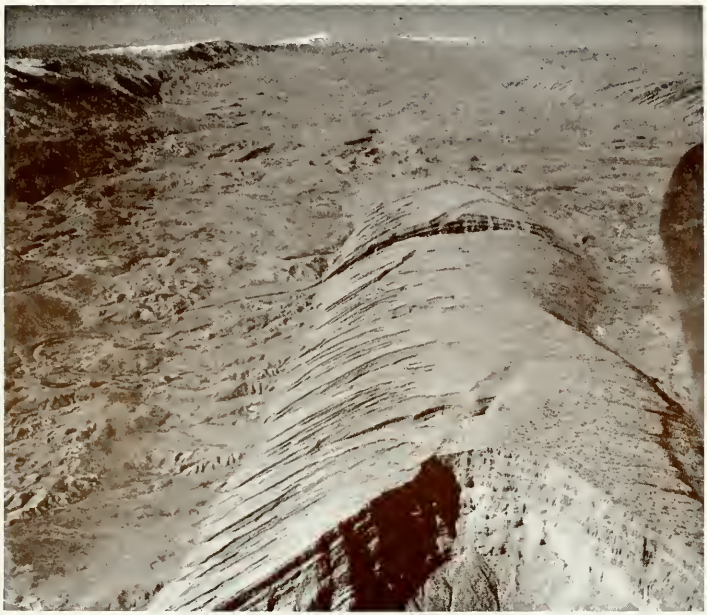
Mountain building and the theory of global plate tectonics

Bertram G. Woodland



Very large fold, Zagros mountain belt, southwest Iran. Cliff in foreground is 1,000 feet high. Photo by Hunting Surveys, Ltd. for the British Petroleum Co., Ltd.

Mountain building, called orogenesis, is a major earth process which results in a relatively narrow but long zone (hundreds of miles to thousands of miles) of thickened, complexly deformed, altered, and uplifted continental crust. The external forces of weathering and erosion act on the zone to produce the characteristic high mountain ranges and intervening deep valleys seen in the present young mountains of the Alps, Andes, Himalayas, and other ranges. Older mountain belts generally show more subdued relief (although they may have been rejuvenated by vertical uplift)—for example, the Appalachians. Very old mountain belts no longer form high ground, but their linear trend may be seen in the complex structures and rock types of their deformed roots now exposed to view.

Some of the major characteristics of complex orogenic belts and various theories of their origin were described in a series of *Bulletin* articles between November 1965 and May 1966. A new and more inclusive theory, referred to as "the new global theory of plate tectonics," has been elaborated since then.

"Tectonics" pertains to the deformational structures present in an area or body of rock. "Plate tectonics" is thus concerned with deformational processes involving plates, the major segments of the upper thin rigid lithosphere of the Earth. The lithosphere includes the crust and part of the upper mantle, and is usually some 40 to 60 miles thick, although thinner in some zones and perhaps thicker in others.

The basic concepts of the theory are simple. It has acquired quick prominence and widespread acceptance, mainly perhaps because for the first time many dynamic and tectonic facts and theories, including orogenesis, are successfully integrated into a logical global tectonics.

The development of the new theory is related to the vastly accelerated pace of scientific discovery within recent years. The number of scientists has grown, but more importantly, sophisticated new instruments have been developed, and there has been a vast increase in the total number of instruments of all types being used. The results are nowhere seen better than in the mass of data now available concerning the ocean basins—which are some 70% of the Earth's surface. Prior to some twenty years ago our knowledge of the physiography of ocean floors and the geology of the oceanic crust and sub-crust was very poor. Since then numerous highly instrumented oceanographic surveys have produced maps of the floor and information on sediment thickness and age and crustal characteristics. The techniques used have involved both direct drilling and remote sensing of such features as magnetic and gravity anomalies and heatflow. Sub-crustal information has been improved by better seismographs to record shock waves generated by natural earthquakes and man-made explosions, such as underground nuclear blasts.

From all these data a clearer picture of the oceanic crust and sub-crust has emerged. Although contrasts with the continental crust have been further emphasized, the new information has made it possible, for the first time, to erect a theory which depends on and integrates the voluminous data on the structure and history of both the continental and oceanic crust.

The Earth may be likened to a heat engine: a source of internal heat (radioactivity) drives internal dynamic processes, whose most obvious manifestations to us are earthquakes (indications of stress) and volcanoes (melting products at high temperatures).

These now better understood processes are important components of any conceptual model of global dynamics. But other necessary components involve interpretations of the morphological, structural, and compositional data on the crust and sub-crust. The model, then, in turn, enables us to look again at the accumulated data on the continental crust, particularly that exposed to our view on the land surface, and reinterpret them and attempt to develop a more rational view of the evolution of the large-scale features of the Earth's crust through geological time.

The boundaries of the plates that constitute the lithosphere are of three fundamental types. Mid-oceanic ridges form an undersea mountain system 35,000 miles long with a central rift along much of its length. The rift marks one type of boundary between plates. A second type of boundary is comprised of deep sea trenches with associated arcs of volcanic islands (such as the Aleutians) or cordilleran mountain ranges and volcanoes (the Peru-Chile coast, for example). The full extent of these oceanic features was revealed by the late 1950s to early 1960s. Also revealed were magnetic anomalies of the sea floor and major fracture features which offset the mid-ocean ridges. These fracture features, called transform faults, comprise the third boundary type.

Recognition of these global features, added to many other tectonic data and theories, undoubtedly contributed to the concept of sea-floor-spreading, enunciated in 1962. As part of this concept, the mid-ocean ridges were interpreted as sites of upwelling of molten rock from the mantle, thus producing new sea floor material, which then spreads away from the ridges and ultimately plunges downward into the mantle at the site of the trenches.

Subsequent additional information and interpretations have served to emphasize the plausibility of the theory that the sea floor is spreading. For one thing, magnetic anomalies of large areas of the ocean floors have been mapped. Positive and negative strips characteristically parallel the mid-ocean ridges. More remarkably, the anomalies on one side of a ridge are the mirror-image of those on the other. The strips were interpreted to be the result of volcanic rock welling up at the center of the ridge, cooling, and acquiring a characteristic magnetization from the Earth's magnetic field. The alternately positive and negative character of the strips was explained as the result of the Earth's magnetic field having reversed many times in the past. The fact of the reversals had been discovered from study of the magnetic directions in lava flows. By establishing independently the dates of lava flows, a chronology of magnetic field reversals has been established for the last few million years. The chronology, applied to the magnetic alternations on the ocean floor and extrapolated to about 80 million years ago, thus in effect establishes when the strips of oceanic crust were formed.

Evidence from sediments obtained by drilling in the deep ocean and extracting core samples also offers confirmation because the total age of a sediment column increases away from the ridges.

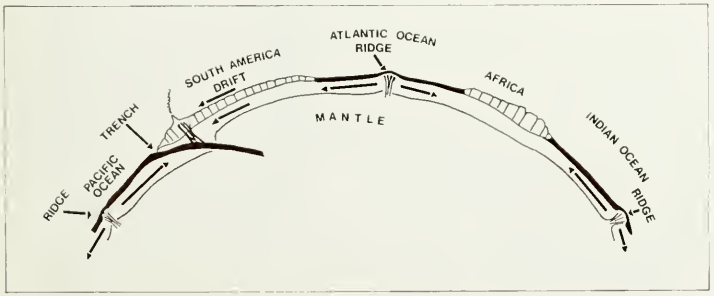
Analysis of seismic waves from earthquakes originating at the ridges, trenches, and transform faults shows that they also are consistent with this tectonic model. Earthquakes in the central rift regions are shallow (less than 6 miles deep), originating in the cooled zone, and indicate outward lateral extension of the lithosphere. Those in the trench region are confined to a thin zone and dip away from the ocean into the mantle under the volcanic island arc or neighboring continent to depths as great as 440 miles. They indicate that there is extension or stretching in the shallowest region, which is where the cool lithosphere bends down. Below this there is underthrusting to depths of about 45 miles. Further below, the data indicate compressional forces parallel to the sinking lithosphere slab. Earthquakes originating on the transform faults indicate sideways slippage of one slab of lithosphere against the other.

All these findings have combined to make a picture of lithosphere slabs or plates interacting at their boundaries. These boundaries mark the active tectonic zones of the Earth, with the plates themselves acting rigidly and relatively free from deformation.

The concept of plate tectonics holds that the continental crust (averaging about 20 miles thick) is like a passenger on the moving rigid lithosphere plate 60 or more miles thick. Some continental margins—the western coastline of Central and South America—coincide with plate boundaries, have an offshore trench, and are tectonically active. Other continental margins—the Atlantic coastlines—lie within a plate and are not tectonically active.

The Atlantic is geologically a young ocean, formed by rupture of continental crust and lateral spreading of new oceanic lithosphere that welled up from the site of the present mid-Atlantic ridge. The western Pacific is marked by plate boundaries at which one plate is being consumed by downward movements into the mantle at the site of deep sea trenches. This explains the

Schematic vertical section of lithosphere and upper mantle showing oceanic lithosphere (black); continental lithosphere (vertically lined); and plate boundaries at ridges and trench. The asthenosphere part of the mantle is less rigid than the lithosphere.



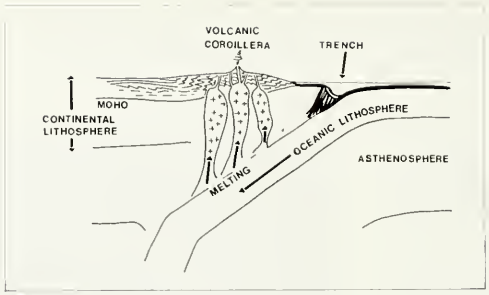
marked tectonic differences between the Pacific and Atlantic margins. The San Andreas fault of California is also a plate boundary, a transform fault connecting ridges in the Gulf of California (a new ocean, like the Red Sea and Gulf of Aden) with ridges off the Oregon coast. The plate to the west of the fault is sliding laterally northwestward relative to the American plate to the east and explains the earthquakes of the area.

Two major concerns of earth science can be neatly and persuasively accommodated within the framework of plate tectonics. They are the theory of continental drift and the explanation of orogenic belts and orogenesis. The continental drift theory received new impetus during the early to mid-1950s from the findings of paleomagnetic directions in continental rocks. These are the directions along which the rocks were magnetized in the Earth's magnetic field, from which can be determined the apparent pole position at the time the rocks were formed.

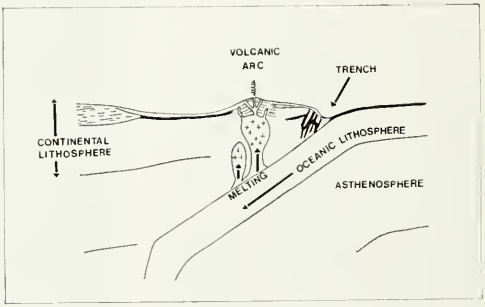
Study of rocks of different ages revealed that the position of the pole has changed throughout a large segment of geological time and, further, that this polar wandering path for the North American continent was systematically displaced from that of Europe except for the last few tens of millions of years, when there is an approximate convergence. The displaced curves were explained by continental drift. Since then many additional data have been added, so the continental drift theory is now reinstated and respectable.

The complex structures and rock types of mountain belts can reasonably be explained by the plate tectonic theory. They are the result of the dynamic effects produced where one lithosphere plate underthrusts the leading edge of another plate. There appear to be four main varieties of such interactions, which are shown in the accompanying drawings.

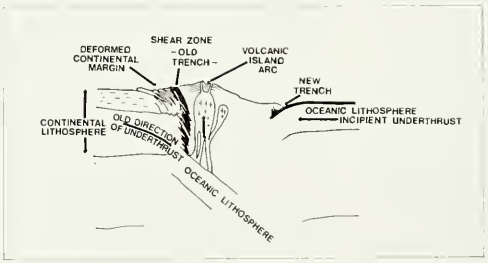
One variety occurs as follows. Where the oceanic lithosphere slab bends down and thrusts beneath a continental margin, a deep trench is formed—for example, the Peru-



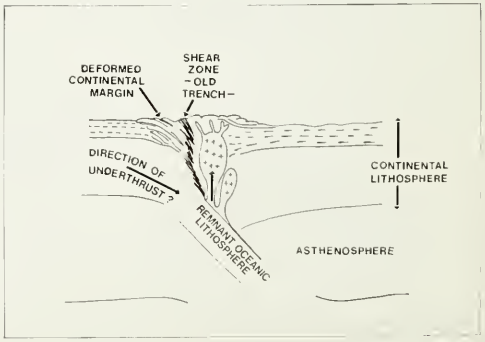
Schematic vertical section of lithosphere depicting one type of mountain building at plate boundaries: the oceanic lithosphere underthrusts a continental margin.



A second variation of mountain building at plate boundaries: an oceanic plate underthrusts another oceanic plate, creating an island arc.



A third variation of mountain building involves collision of an island arc and continental lithosphere. The underthrusting that produced the collision has ceased and a new direction of underthrusting has started.



A fourth variation of mountain building occurs when two continental lithosphere plates collide. A shear zone of oceanic lithosphere and sediments marks the site where the former ocean was closed. The compression and underthrusting which suture two continents create a wide zone of deformation and thickened crust.

Ecuador trench. Oceanic crust and sediments may be squeezed, scraped off, and sheared at the inner trench wall and partly carried down with the slab. Where the slab enters the mantle, it penetrates a zone where the velocity of seismic waves diminishes, which suggests that the rock of the zone is near its melting point. This zone is presumed to behave more plastically than the rigid mantle above and below it, and is given the name asthenosphere. The added frictional effects result in further heating and melting, so that liquid rock, or magma, rises in large volumes to form volcanoes and igneous intrusions into the continental crust. The heat also causes extensive recrystallization and metamorphism of sediments deposited on the continental margin. If the plate consumption slows or stops, readjustment to the force of gravity causes uplift of the sheared masses of sediment, lava, and pieces of oceanic lithosphere that were jammed together beneath the trench. Such zones are recognized in the complex and chaotic belts of the California Coast Ranges, for example. Further evidence of the probable origin of such zones is the presence of rock types indicative of the deep ocean floor—chert, lava, and serpentine. Such altered igneous rocks may represent the lower oceanic crust or upper mantle. These rocks, together with sediments poured into the trough, were recrystallized under conditions of high pressure and relatively low temperature. Uplift and continued igneous activity in the high-temperature orogenic zone are accompanied by deformation, gravity-sliding off the uplifts, erosion, and sedimentation in marginal basins.

The second variety of orogenic belt arises when an oceanic plate underthrusts another oceanic plate and creates both a trench and beyond it a volcanic island arc above the high-temperature zone. Most of the effects associated with underthrusting as described above are present except that the high-temperature orogenic belt is constructed on oceanic lithosphere from volcanic activity and its erosional products. No continental crust is present. Modern examples are the Aleutian and Bonin-Mariana arcs and trenches.

The other types of interaction involve collisions of continental crust with either an island arc or another continental lithosphere plate. In the case of the former, the oceanic crust originally separating the arc from the continent is consumed and the arc is welded to the continental crust along with the sedimentary accumulation along its margin. The relatively less dense continental crust resists underthrusting. Thus the results are considerable shortening by such processes as complex folding and thrusting. The underthrusting ceases, followed by uplift and erosion.

Collision of two continental lithosphere plates is a mammoth event which involves closure of an ocean and consumption of the oceanic lithosphere beneath one or both continental margins. As the two continental slabs approach each other, the wedges of sediment at the margins and the tectonic mélange of the trench zone converge and are squeezed up and thrust onto the continents. The partial underthrusting grossly overthickens the continental crust, which then rises to great elevations across a very large area. Such a process may be the explanation of the Himalayan Mountains and Tibetan Plateau. Again, the closure of the ocean will be indicated by a narrow zone of rocks from the oceanic plate and trench.

These theories of mountain building were constructed from data on the relatively young tectonic features of the Earth. By re-examining the data on more ancient orogenic belts and applying the theories to them, we can attempt to decipher their structures and rock types in terms of plate tectonics.

Thus the Appalachian mountain belt appears to be the result of a long, complex history commencing over 600 million years ago with the rupture of a continental plate and growth of an early ocean in roughly the same relative position as the present Atlantic. After some 300 million years of complex events involving island arcs, trenches, and orogenies at plate margins that were being consumed, the ocean closed in a major orogeny that welded the European plate to the North American. Subsequently a new rupturing occurred, commencing about 200 million years ago. Active formation and spreading of the modern Atlantic probably started about 120 million years ago. The rupture does not coincide with the preceding weld or suture, but it parallels it fairly closely and apparently crosses it. The Ural Mountains may mark another suture zone of two continental plates. Other such suture zones of much greater age have been proposed, with the implied suggestion that plate tectonics or a modified form of it has been operative for several billions of years.

Many problems remain to be solved relating plate tectonics to geological and dynamic aspects of the Earth. For example, there is the question of how much the volcanic arcs represent new additions to the continental crust derived from the mantle or from re-melting of oceanic lithosphere, and how much is recycled material derived from sediments worn off the continents. Another problem is that there is no ready explanation for the earthquakes that occasionally occur *within* lithosphere plates rather than at the margins, such as the Mississippi Valley shocks. Such earthquakes apparently are caused by slip along ancient fractures of the crust.

The importance of the plate tectonic theory is not only that it explains and integrates major dynamic processes of the Earth. Although many aspects of the theory are not new, its ability to tie together many seemingly independent aspects of the Earth's evolution raises it to the status of a general theory. It thus provides a new way of looking at the geological data on the Earth and a powerful way of re-interpreting broad aspects of the Earth's geological history. It has repercussions for students of evolution and the distribution of the world's flora and fauna. It also has implications for the search for new mineral resources, because their occurrence is directly related to the dynamic processes operating within the Earth.

Dr. Bertram G. Woodland is curator of igneous and metamorphic petrology, Department of Geology, Field Museum.

The Early History of the Geology Department

Eugene S. Richardson, Jr.

Paleontology laboratory, 1899.

When the Museum's Department of Geology sprang from the brow of Zeus in June 1894, it was not full-panoplied. The staff on Opening Day consisted of a scientist and a label writer, joined a month later by a second scientist.

Oliver C. Farrington, curator of geology, was a young man of 30, with a B.S. from the University of Maine (earned at the age of 17) and a Ph.D. from Yale. "The Deacon" (as his Yale friends called him) was already as well acquainted with the Field Columbian Museum as anyone, for while at the U.S. National Museum in 1893 he had been assigned to help put together the geological exhibits for the World's Columbian Exposition, and had even come to Chicago to supervise their installation. At the close of the Exposition the collections that were transferred to the new Museum included those of the Exposition's Department of Mines, Mining and Metallurgy. It was the chief of that department, Frederick J. V. Skiff, who became the Museum's first director. To establish the new Department of Geology and to install its exhibits, Skiff called the man who already knew the material.

From December 1893, when the first of the collections started arriving, to June 1894, when the Museum was formally opened, was an apallingly brief time for what had to be done. Geology exhibits were planned, created, and installed in 21 exhibit halls in those six months. Farrington and the label writer could have had virtually no time for other pursuits in their little three-room suite of office, library, and laboratory.

The very name of the scrivener has been lost, and I'm not sure that any of his india-ink labels survive. But Farrington held the helm of this department for 39 years. His "Handbook and Catalogue of the Meteorite Collection" (August 1895) was the Museum's first scientific publication. The following winter he left on Geology's first "expedition," a trip to Mexico, where he climbed Popocatepetl and explored its crater, and climbed Ixtacihuatl far enough to study its glacier. He brought back ores and rocks for the already growing collection. Ores and rocks were the usual focus of his field work, though for most of his three months in South Dakota in 1898 he was collecting fossil mammals in the Bad Lands, and once while collecting minerals in the interior of Brazil in 1923 he happened upon and collected a portion of a large fossil ground sloth.

Farrington's broad interests in mineralogy are reflected in his 101 scientific and popular publications, but his particular enthusiasm is shown by the fact that 36 of these are on meteorites. He once remarked in print that "no survey of Nature can be considered complete which does not include an account of them." By the time of his death in 1933, Farrington had brought the Museum's representation of meteorite falls from short of 200 to almost 700, and the Museum had become recognized as an important center for meteorite study, with the most complete collection in the world.

The junior member of the infant department, Henry W. Nichols, remained at the Museum for 50 years, until he retired at the age of 76 in 1944. He was a graduate of Massachusetts Institute of Technology and had been on its teaching staff before coming to the Museum. His field work, like Farrington's, usually involved ores and rocks, but he often

made observations and measurements to be used in making models of landforms to show geological processes, or of industrial installations to illustrate the recovery or use of geological products. In 1917 he took his surveying equipment to Natural Bridge, Virginia, then accounted one of the noblest sights of our continent. The director reported: "The survey made by the Assistant Curator is, so far as known, the first detailed survey of the Bridge that has been accomplished since that conducted by Thomas Jefferson shortly after the close of his term as President." In the succeeding months Nichols and a preparator or two constructed the scale model that is still on exhibit. I particularly like that model; shortly before "the Assistant Curator" arrived with his theodolite, my own parents had had their honeymoon at Natural Bridge.

In his full-panoplied prime, Dr. Nichols wore a neatly trimmed full beard, perhaps the inspiration for the nickname of "Foozleduck" affectionately used behind his back. He was stubbornly attached to that beard, even when it met with an accident while he was investigating a gold mine near Porcupine, Ontario in 1919. Overtaken by a forest fire, he had to dive for the only available refuge, a shallow stream. As the fire swept past, it impartially consumed the right side of the beard along with the grass and shrubbery. Otherwise unharmed, Dr. Nichols rose from the ashes, dusted himself off, and returned to Chicago and the Museum with half a beard.

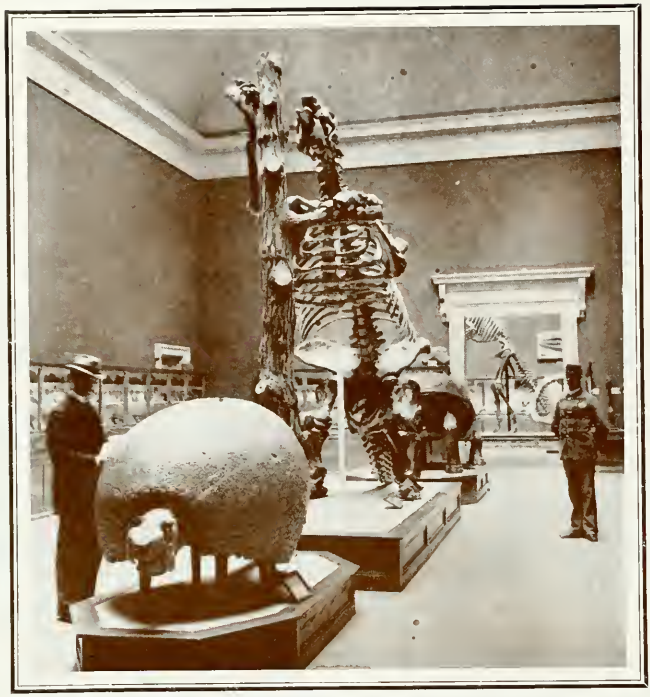
His colleagues throughout the Museum knew Dr. Nichols as a thoughtful and gracious person, generous of his time and talents. Though as an elderly man he might sometimes doze off at his desk, his ingenuity was unimpaired. In 1936, addressing himself to an anthropological problem, he devised a chemical treatment for the malignant patina afflicting some of the ancient bronzes, and treated many of the specimens himself. Three years later, faced with the need for large slabs of rock for study and exhibition, he and his preparator, Val Legault, devised the peculiar instrument that is still respectfully reassembled when the same need arises: the "meteorite saw," based on a reciprocating strap of steel and a sludge of abrasive. In 1942, when military enlistments had decimated his department, the 74-year-old chief curator, with the help of the one remaining preparator, personally installed the new exhibit of industrial minerals that occupied an entire half of Hall 37.

Normally, of course, the department has not been so short-handed. From the first there were laboratory assistants, and Dr. Farrington even had a helper to go with him to the Bad Lands in 1898. This was Elmer S. Riggs, graduate of the University of Kansas and then a graduate student at Princeton. The next year Riggs was appointed assistant curator of paleontology and had his own "expedition"—to Medicine Bow, Wyoming, with H. W. Menke as an assistant. They shipped back five tons of miscellaneous pieces of Jurassic dinosaurs. For the next 41 years Riggs was often in the field, collecting fossils in well-known localities. When he and his preparator, John Abbott, were working in the Red Deer Valley in Alberta in July 1922 with George Sternberg, a well-known professional collector, he received word that the Captain Marshall Field Expedition to Argentina had been approved. The three men struck their tents, crated their ten tons of dinosaurs and other fossils, and hurried back to Chicago. By November they had everything ready and sailed for Argentina. For five years Riggs and various assistants, including his brother Harold, collected in Argentina and Bolivia. Many of the fossils they sent back are still among the spectacular exhibits in Hall 38.

Hall 38 is dominated by the large *Brontosaurus* skeleton. Its tail, hindquarters, and trunk were collected by Riggs and Menke near Fruita, Colorado, in 1901, and within the year the individual bones were being separately put on display as they were prepared. The assembled hind end of *Brontosaurus* remained an imposing but incomplete exhibit for a couple of generations, until James Quinn and Orville Gilpin in 1941 collected a matching neck and forequarters in nearby Utah, and Gilpin made the present composite mount. A bronze tablet erected by a local newspaper marks the site of Riggs' 1901 excavation. In that same area Menke came upon portions of a still larger dinosaur, which Riggs described in 1903 as *Brachiosaurus*, the largest known reptile.

Naturally, the spectacular vertebrates were the first fossils to receive formal attention, but as the department grew, an assistant curator of fossil invertebrates, Arthur W. Slocom, was added in 1906. For a while it was a four-man department, and Slocom's annual field trips to New York, Michigan, Iowa, or Illinois added hundreds of Paleozoic invertebrate fossils to the study collections. Among these were many new species, which he described in five Museum publications. Slocom left in 1913 to become curator of the Walker Museum of the University of Chicago, and the senior staff was again down to three until 1925, when Sharat K. Roy took Slocom's old job.

Before Roy came to the United States from his native India he had studied at the Universities of Calcutta and London, and had served during World War I in the British-Indian Army. In this country he earned a master's degree at the University of Illinois and a Ph.D. at the University of Chicago. He later succeeded Dr. Nichols as head of the Geology Department. Hardly any Indians have become sub-arctic explorers; Sharat was scarcely well settled at the Museum before he joined the 1927-28 Rawson-Macmillan Expedition to Baffin Land and Labrador, as geologist for the Museum. After a summer of geological and other observations on Baffin Island, the party moved into winter quarters at Anatalak Bay, Labrador. "Labrador seemed warm in comparison to our sojourn in Frobisher Bay, but soon the whizzing hordes of insects yielded place to snow and sleet, and, before we had time to realize it, winter came with its biting wind and killing cold. . . . But despite adverse conditions, the lure of



the Arctic is irresistible." A photograph of their winter quarters (which they built themselves) shows a comfortable frame house deeply banked with snow.

The four Field Museum men—Art Rueckert, artist-taxidermist; A. C. Weed, ichthyologist; Duncan Strong, anthropologist; and Roy, the geologist —were, on the whole, adequately provisioned. But toward the end of winter Rueckert and Roy found that because of unforeseen depletion of one critical resource, it was necessary to dip now and then into the supply of alcohol that Weed had brought along for preserving his fishes. They were careful to maintain the level by judiciously adding water. This makeshift served them well for a few weeks, though they did feel that the quality was consistently deteriorating. The aperitif hour was abruptly discontinued when they returned one day from a brisk walk to surprise a colleague dry-cleaning his underwear in the alcohol.

Nevertheless, Roy always held happy memories of the arctic. His connection with Baffin Island was recognized some years later when a chart of the United States Coast and Geodetic Survey was published with a "Mount Sharat" indicated on the shore of Frobisher Bay. This was rather a surprise to the Canadians, but they took it in good part, particularly as it later appeared that there was no mountain in that vicinity anyhow. The name had been applied in some distant office to a purely conventional group of form-lines that someone noticed on the locality map, redrawn from Charles Francis Hall, which Roy had included in his 1941 monograph on the results of the expedition.

Roy was a mild-mannered man, often shy, often with a driving sense of urgency. One of his colleagues who bought a car that Roy had owned for a few years found that it took him a couple of months to get the accelerator pedal to accept the intermediate positions between full throttle and none. We are reminded that "getting there is half the fun" as we recall an occasion when Roy set out from Chicago to collect fossils in upper New York State, and didn't notice until he came to a bridge across the Mississippi that he had made a wrong turn somewhere. His drive for perfection was familiar to his friends in the elaborate care that he invested in preparing one of his famed curry dinners. The repast might be delayed for three hours while the proper nuances were developing. Such Oriental patience led him once to spend three weeks systematically hunting for fossils at a Newfoundland locality before finding the richly fossiliferous layer that made it all worthwhile.

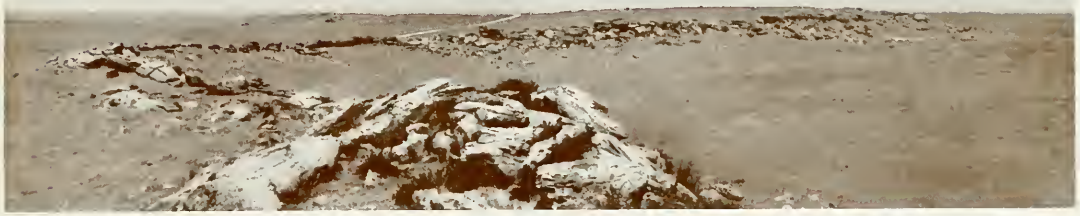
Sharat Roy's first interest was paleontology, and particularly fossil invertebrates. When he was serving as an officer in the U.S. Army Air Force in the Indian Theater in 1945 (he had asked for arctic duty!), he spent a month's leave making an extensive collection of Permian fossils for the Museum in the classic Salt Range locality in the Punjab. But upon becoming chief curator after the war, he felt an obligation to broaden his interests to other geological fields. He had already made some glaciological studies on the Rawson-Macmillan Expedition; now for a period of nine years he made field studies on the volcanoes of Central America, interspersed with studies of certain stony meteorites that took him to collections in Europe and India. When he died in office at the age of 64, he had published 62 papers in a variety of fields.

This brief sketch has covered only the beginnings of the Museum's Geology Department. The four scientists so cursorily introduced established its direction and some of its traditions; together they gave a total of 160 years to the Museum. In the years between and overlapping these men and those of the present staff, who are introduced elsewhere in this issue, is another dozen of strong and present memory who continued this history. They must await a sequel—which, if public clamor is sufficiently raucous, will appear in a future issue.

Dr. Eugene S. Richardson, Jr. is curator of fossil invertebrates, Department of Geology, Field Museum.

"The mile-wide mutterings of unimagined rivers"

John Clark



Kipling's Explorer would feel lost in our modern world: there are no unimagined rivers left to explore.

But he need only step back into the past to explore the unknown again. What were the landscapes of thirty million years ago? Or forty million, or one hundred million? Where were the mountains, and what rivers inexorably wore them down? What continents enjoyed tropic balm, where were the deserts, and where and when did ice ages chill the Earth? It is our privilege to search for answers to these questions, to ask the rocks and try to understand what they may tell us.

For example, consider the picture of the northeastern Colorado plains, with a sinuous ledge of sandstone sweeping across them.

That ledge was once the course of a meandering stream, and the sandstone is the sand and gravel that formed its bed. How wide was the stream, and how deep? As wide as the broken ribbon of rock, about 100 feet, and as deep as the thickest cross-beds, about 4 feet. How fast did the current flow? About 5 miles an hour, judging from the size of the pebbles that it carried. And where were its headwaters? In a particular section of the Colorado Front Range, just at the Wyoming-Colorado border, because only there do granites of the types found in its pebbles occur together.

A little arithmetic shows us that this 35-million-year-old river carried about 1,500 cubic feet of water per second, when it was running bank-full. That would be smaller than the Fox and the Desplaines Rivers, and somewhat larger than the Du Page. The stream was, naturally, both swifter and cleaner than our rivers in northeastern Illinois.

Studies like this, of every 35-million-year-old stream deposit from Colorado through Montana, make possible maps of ancient geography. From them we can estimate, roughly, the runoff and the rainfall of the past. Falls of ash from ancient volcanoes give us direction of prevailing winds; and fossil animals and plants, plus rock chemistry, tell us something of temperatures. So we can build a history of Earth's topography and climate, through time.

As a visitor once said to me, "So what? That rain won't get me wet, and these rocks aren't even pretty! Why do this?"

There are three answers to that question: my own reasons, the reasons of science, and practical reasons. My own reasons are simple: I find this the most fascinating exercise on earth. Even if it had no practical application, I would do it.

From the standpoint of fundamental science, this information fits into the whole body of Earth history like the missing pieces of a puzzle. Indirectly, it helps us to understand stream action, flood plain deposition, and climatic controls.

From the entirely practical viewpoint, the action of streams relative to their flood plains is most important. Billions of dollars worth of property and millions of human lives the world around are affected by it. We can never be sure when one piece of information from the past may be the one we need for better control of rivers.

More directly, study of past climatic change is important to us. We have learned that climates change rapidly, even by human let alone historic standards. In 1870 Chicago had the cool temperatures that presently affect Green Bay, Wisconsin. Our climate warmed rapidly from 1870 to 1955. Since then it has cooled rapidly. If this cooling trend continues, the Russian and Canadian wheat-growing regions will be wiped out. If it reverses and the climate warms up again, Texas and Kansas may find wheat growing impossible. Groundwater for our suburban areas, and the very existence of Lake Michigan, will be affected.

I'm not an applied scientist, nor does Field Museum work in applied science. It is our job to learn the fundamentals about climatology so the applied scientists can put those fundamentals to human use. Neither the fundamental nor the applied scientists can function without the other half of the team. We in the Geology Department are proud of our responsibility.

Dr. John Clark is associate curator of sedimentary petrology, Department of Geology, Field Museum.

Light blue topaz, 167 carats, cut from crystals in background.

The Rest of the Iceberg

Katherine Krueger

When visitors view the many cases of geologic specimens in the exhibit halls, they see only a tiny fraction of the total collection. The exhibit specimens have been selected to best represent the diversity among fossils and rocks. Many hundreds of thousands of other specimens lie in storage in the research areas of the Museum. Exhibition is only one function of this Museum; maintaining collections for study is another. What criteria determine the contents of a collection? How are these collections used? Why do we amass such great numbers of specimens? And how are they maintained?

No museum has a collection that represents a complete record of Earth's natural history. New fossil species of plants and animals and previously unknown rocks and minerals are still being discovered. In the case of rare specimens, what one institution has, another may lack. The geologic collections of Field Museum are specialized and shaped around many people's interests and goals.

Although field collecting is the primary source of specimens, purchases and gifts are valuable supplementary means of acquisition. Indeed, our original collections were acquired by purchase of fossils, rocks, and minerals from the Columbian Exposition of 1893. Our collections in every branch of paleontology were greatly enriched when the University of Chicago entrusted its fossil collection to Field Museum as a permanent loan. The fossil plants and vertebrates came to us in the 1940s and '50s, while the enormous fossil invertebrate collection of over one million specimens arrived during the 1960s.

A museum is well suited for research and for maintenance of collections because it has the necessary staff and the storage space for vast numbers of specimens. Research into geologic history—which is, after all, responsible for our present-day ecosystem—is the main basis of our understanding of our present-day environment and of our expectations of the future. The extensive collections of a major museum also permit the researcher to take inventory of living and extinct species and to study their ecological and evolutionary relationships.

Our collections are frequently used by specialists and students from other institutions as well as by our own curatorial staff. It would be extremely difficult for investigators around the world to do research were it not for the cooperative loan policies of major museums. Certainly one would be greatly limited as to what field of study one could pursue. Whenever a researcher requests a loan of material in the museum collections, the specimens are promptly sent to him.

The geology collections are subdivided into mineralogy, sedimentary petrology ("soft rocks"), igneous and metamorphic petrology ("hard rocks"), economic geology, biostratonomy, and paleontology. The last is further broken down into fossil mammals, birds, reptiles, amphibians, fish, invertebrates, and plants. Within these collections, some specimens or groups of specimens are in more demand than others.

In paleontology our type specimens are among the most frequently loaned. A "type" is the specimen upon which the original description of a species is based. All subsequent specimens of the species should be compared with the type to ascertain their proper identification. Our collections are especially significant because they include many type specimens in every branch of paleontology.

Within the rock collections, meteorites are most frequently requested. Like type specimens, meteorites are unique and irreplaceable. Their haphazard occurrence and extraterrestrial origins make them the rarest of rocks—only about 1,860 meteorites are known to exist. The tests for which a meteorite is requested often require just a tiny chip (a few grams in weight), which is sent to the requesting party. The weight of each meteorite is carefully recorded, and each time a chip is removed the specimen is reweighed before being stored again.

Keeping all the specimens readily accessible and retrievable through organized storage and information classification systems is our first job.

All the specimens in the collections must be numbered in permanent ink and the information entered in a catalog. Thus each specimen can be precisely referred to in a publication and can be located for further study. In the catalog the following items are noted in as much detail as possible: the name of the fossil, rock, or mineral, with a description where pertinent; the number of specimens assigned to that number (applies where several of one species come from one site and level, for example); the collection locality; the geologic age and formation; in some cases, the size and weight; the minerals present; the texture (these last two apply only to rock specimens); the collector, seller, or donor and the date of acquisition; and the date of entry in the catalog. The catalogs are columned ledgers with headings for these categories, of paper chosen for its durability.

The catalog entries are in chronological order and thus do not indicate how many of any particular group we have. Therefore, some divisions find it practical to keep file cards which duplicate each catalog entry. The cards are filed and cross-filed for easy reference to a particular group of specimens. For vertebrate fossils the cards are arranged in taxonomic order, with geographic or geologic breakdowns within large groups. For "hard rocks" there are two files, one arranged geographically, the other by type of rock. The sedimentary rock information is punched onto special large cards that reveal similar data by punch alignments.

When a specimen has been cataloged, it is placed in a tray for protection with a numbered label that bears basic information about it. The trays, which come in six sizes, conform to wooden drawers, which in turn fit into large metal cabinets. The order of the specimens in these drawers and cabinets is somewhat parallel to the order of the file cards; that is, the rocks are arranged by geographic locality or by type of rock, and the fossils by taxonomic groups, age, or locality. However, within each subdivision of paleontology, a slightly different arrangement is used in order to correspond to the size and nature of the collections. Fossil birds, reptiles, and fish are arranged strictly according to taxonomic order. Fossil mammals and plants are arranged first by geologic time sequences and secondly by geographic localities. Within these localities they are then arranged taxonomically. In this way faunal or floral assemblages are stored together. Because fossil invertebrates are so abundant, both in terms of population size and in numbers of species, it would be impossible to arrange them in taxonomic order, down to the finest division. A specialist for each division would be needed, and that would be more specialties than any museum staff could cover. Therefore the fossil invertebrates are grouped first by geologic time periods, then by gross taxonomic divisions. Within these large groups, the specimens are arranged alphabetically by generic names. When convenient, a geographic breakdown is also used. The numerous type specimens of invertebrate fossils are stored in separate cabinets for greater accessibility.

The mineralogy collection is arranged according to the Dana numbering system, which is much like the Dewey Decimal system of a library. This numbering system makes it possible to keep related minerals together, just as taxonomic systems do for animals and plants. Meteorites are arranged alphabetically by the geographic name of the place where each fell.

The whole cataloging procedure may get a face-lift in the near future. Because the ledger and file card system is expensive (in both the time it takes and the price of high-quality paper), and because voluminous amounts of material continue to accumulate, cataloging by computer becomes more and more a possibility. The Geology Department already has one toe in the water in that the Division of Fossil Mammals has converted completely to computer cataloging. This division, a guinea pig, has worked out a computer program that conforms to our research needs but is flexible enough to be applied to an international data clearinghouse, should one system ever prevail. At present there are no common standards among museums for programming the data entries.

Let us now tour the actual collections, for which the Geology Department is so well known. We can see only a few highlights, for the vastness of this iceberg cannot be surveyed by one explorer on a single journey.

The original mineralogy collection has been greatly supplemented through purchase and gifts, including many valuable gems and pieces of jewelry that have been acquired over the years. From the Ural Mountains carving industry of Catherine the Great, we have beautiful carved ornamental stones. Also from Russia came an outstanding collection of blue topazes. The recent gift of the Chalmers topaz, found in Brazil, gave us the largest faceted blue topaz in the world. We also have the largest gem aquamarine from the United States, which came from Stoneham, Maine.

The many thousands of specimens within the research collections well represent the world's known minerals. More common minerals are represented from several localities. One odd feature of this collection is the predominance of fluorites from localities in England rather than from Illinois, the fluorite state. Among the world's rare minerals are those of the osumilite group. Field Museum has specimens of every member of that group from all of the world's known localities (three!). Thus our specimens have been of great importance in studying and establishing the distinctive crystallographic properties of this group.

Our collection of meteorites is one of the best in the world. The different kinds are well represented and the specimens are large enough to take samples of for analysis. One significance of meteorites is that they represent the primordial matter of the solar system, unchanged by weathering. Through study of them we can answer many questions concerning the origin of the planets. We have been fortunate to acquire 70% of the Murchison Meteorite, which fell in the environs of Melbourne, Australia in October of 1969. This particular meteorite is currently under intensive study around

the world because it has traces of amino acids, the building blocks of living things. Their presence may be an indication of extraterrestrial life.

The sedimentary rock collection became a separate division within the overall rock collection in the 1960s. Continental sedimentary rock types—fluvial, lacustrine, and aeolian—are very well represented. The collection has three parts, consisting of (1) an old collection of sedimentary rock types from around the world; (2) a demonstration-exhibition series of sedimentary rock structures such as ripple marks, concretions, cone-in-cone, and fulgarites; and (3) a research collection which includes rock specimens under study by our own curatorial staff or scientists from other institutions.

Research collections of rocks are always accompanied by a sub-collection of thin sections—specially prepared slices about 0.03 of a millimeter thick, mounted on glass slides. It is usually impossible to identify or describe rocks from a hand specimen. Hence we need to study a thin section under a polarizing microscope. The behavior of polarized light as it passes through a crystal 0.03 of a millimeter thick is distinctive for each mineral and provides us with a means of identification. The shape and color of the crystals can also be diagnostic. Rocks are inherently difficult to study because of the gradation in their composition and structure; therefore, significant criteria must be drawn from examination of as wide a range of variations as possible.

Rocks of economic value, such as ores and building stones, are maintained in a separate collection. Metallic and non-metallic ores and fossil fuels from around the world are represented, including some from mines presently inaccessible or no longer in operation, such as the old gold and silver mines of the American West. Lead, zinc, copper, and iron in particular are well represented from numerous localities.

The biostratonomy collection contains specimens that exemplify the relationship between fossils and the rock in which they are embedded. Usually they exhibit a faunal assemblage which, more precisely than a lone specimen, allows us to determine the setting in which an organism lived. The recent quarrying of Coal Age black shales in several Midwestern states has yielded a rich supply of shark coprolites and stomach ejects, which reveal just what co-existing animals these predators had for lunch.

Within the fossil mammal collection is a wide selection of material from Cretaceous through Pleistocene time in North America. However, our specimens from the Early Tertiary beds of Colorado, Wyoming, and the Big Badlands are especially well

Pennsylvanian insect, *Lithoneura carpenteri* Richardson.

represented and have been the basis of many important publications. Field Museum acquired a sizable collection of South American Cenozoic mammals from a series of field expeditions to Argentina and Bolivia in the 1920s. During an expedition to Australia conducted jointly with the University of Texas, thousands of Pliocene and Pleistocene specimens were collected from caves along the southern coast of that continent. The tiny marsupial and rodent bones and teeth from these caves are so numerous that it will take many years to catalog and study them. Collections from foreign countries facilitate the study of world-wide evolution. It would be a slow and complicated procedure to borrow material from foreign institutions.

An outstanding collection of Permian reptiles came to us through the University of Chicago. Gathered over the years by a succession of famous teachers and students, this collection, which includes many type specimens, has been the basis of some of the most important work in vertebrate paleontology. The Museum has also built up through field expeditions a fine representative collection of North American marine fossil turtles. Our collection of turtles from the Cretaceous Mooreville Chalk of Alabama is the most complete known from this section and contains many type specimens. Consequently it too has been the source for several research publications.

The richly fossiliferous Eocene rocks of the Washakie Basin in Wyoming have yielded us many fine specimens of terrestrial turtles, as well as a unique crocodilian skull belonging to a rare group. Most evolutionary studies of crocodilians are based on skulls, which are more commonly found than the other skeletal parts. Our specimen is the best preserved skull for this particular kind of crocodile, and it provides an important link in knowledge of the group.

Backbone of our fossil fish collection is a fine representation of North American Devonian fishes. The Devonian period was the Age of Fishes, the time of their evolutionary flowering. Our collection, one of the most complete for North American strata of this age, was gathered almost entirely through the efforts of a single researcher, over a thirty-year period. Our fossil fish collection was also enhanced by the University of Chicago holdings and by over 100 Eocene fish from a classic locality in Italy, received in exchange for the skeleton of one dinosaur.

The same Midwestern Coal Age black shales that provided us with so many fine biostratonomic specimens have also been a rich source of shark and fish remains. Many of these specimens were preserved and recovered in an articulated state, not broken and scattered. An entire new order of fish comprising several families, genera, and species was discovered among

these fossils and will be the subject of a forthcoming scientific paper in the *Fieldiana: Geology Memoirs* series. The black shale collections have been built up in part through numerous field expeditions and in part through the gifts of amateur collectors who have worked in close cooperation with Field Museum.

Over many years professors at the University of Chicago and their students have collected invertebrate fossils from the Mississippi and Ohio River Valleys and have published monographs on them. These collections, which are valuable both for the type specimens they include and for the numbers of specimens available for comparative studies, came to us through the permanent loan mentioned earlier. Through that same loan we also received a large portion of the Hall collection of Paleozoic invertebrates, predominantly North American. This huge collection contains many type specimens and has been the basis for numerous publications that have become classics. It was amassed by James Hall, a pillar of the New York Geologic Survey in its early years and one of the founding fathers of North American invertebrate paleontology. He financed publication of his research through the sale of his many collections, much of which was purchased by the University of Chicago.

In the Coal Age shales of northeastern Illinois lie millions of fossiliferous ironstone concretions that yield unusually well preserved plants, invertebrates, and, on rare occasions, vertebrates. They comprise what are known as the Mazon Creek fossils, named from the stream in Grundy County. Their excellent state of preservation permits the paleontologist to study details of insects, spiders, crustaceans, tiny fishes, sea cucumbers, worms, and all sorts of soft-bodied creatures that have normally not survived geologic change. In the 1960s, jointly with the University of Chicago, Field Museum began a massive and still continuing field project which has yielded an immense wealth of complete specimens and new species. The volume of material is great enough to guarantee research topics for many years. Most interesting

GEOLOGIC TIME

Era	*Period*	*Epoch*
Cenozoic	Quaternary	Recent
		Pleistocene (Ice Ages)
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
		Paleocene
Mesozoic (Age of Reptiles)		Cretaceous
		Jurassic
		Triassic
Paleozoic		Permian
		Pennsylvanian (Illinois coal forests)
		Mississippian
		Devonian (Age of Fishes)
		Silurian (Chicago area)
		Ordovician
		Cambrian
Precambrian Proterozoic Archeozoic		

of all perhaps is the enigmatic "Tully monster," which cannot be assigned to any known group of animals. Numerous amateur collectors have also contributed Mazon Creek fossils to our collection, some of which have become type specimens.

Our fossil plant collection may be expected to reflect the geologic setting of Field Museum, and so it does. Through purchases, loans, gifts, and field expeditions we have acquired an enormous collection of plants from the Pennsylvanian period from the strip coal mines of northeastern Illinois. From the Gulf Coastal Plain we also have a leading collection of Cretaceous and Tertiary plants, all of which are in excellent condition.

In recent years "ecology" has become a household word, but an understanding of the intricate interrelationships of living things and the delicate balance between them and their environment would be impossible without the groundwork laid by patient researchers who have been studying the separate parts in minute detail. It is they who have, by examining as many specimens as possible, determined what constitutes species and why and how one differs from another. The research specimens of a museum provide the material for this documentation of Earth's natural history.

The exact definition of a species is still a subject for debate, but one definition that is widely accepted among biologists states that a species is an "interbreeding population" which maintains its distinctive genetic traits through fertile union of the male and female, or through asexual budding. Obviously with fossils we cannot determine which organisms did or did not interbreed. Hence we must use as guidelines the morphologic features, which reflect part of the genetic makeup of organisms. Sometimes, until enough specimens are lined up side by side, the diagnostic features are hard to determine. Two extreme variants of one species, seen without gradational forms, may seem to represent two different species.

To study the geologic history of an area, such as the course of an ancient river and the source of its sediments, one needs to take rock samples from many points. To establish from what direction earth stresses were applied which built up a mountain range over millions of years, or which subsequently metamorphosed its rocks, again numerous specimens from an extensive area are needed. The varied composition of a volcano's rocks give us a peek into the chemistry of Earth's interior. As many researchers around the world laboriously chip away at Earth's surface, gathering their data, one day we will perhaps have most of the pieces of the puzzle and be able to put them into place. We will understand and predict earthquakes and volcanic eruptions, and we will more intelligently manage the natural resources of the ocean and the continents.

Katherine Krueger is assistant in paleontology, Department of Geology, Field Museum.

who's who in geology

patricia m. williams

Rows of coffee cups labeled "Bert, Gene, Bill . . ." hang on a wooden board in the paleontology laboratory. Office walls are lined with photographs of plaid-shirted geologists chipping away at mountainsides. These are tangible indications that the geologists at Field Museum are friends as well as colleagues. However, although unified by congeniality, the department's seven curators have always been encouraged to follow their individual interests and programs. The result is a department diverse in its efforts, covering a wide spectrum of geological endeavor.

Dr. Rainer Zangerl and Dr. Eugene S. Richardson, Jr.

Swiss-born Rainer Zangerl has been chairman of the department since 1962, a position he assumed after serving seventeen years as curator of fossil reptiles. A paleontologist of international reputation, Dr. Zangerl is concerned with providing an interpretation of the environment as it existed in the Pennsylvanian period of the Paleozoic era. "The Paleoecological History of Two Pennsylvanian Black Shales" (*Fieldiana: Geology Memoirs,* Volume 4), co-authored with Dr. Eugene S. Richardson and published in 1963, is a major work focusing on the wealth of material from the Mecca and Logan quarries in Parke County, Indiana. The volume is now a classic and is used as a textbook in graduate seminars around the country.

Dr. Zangerl recently completed a manuscript setting forth a descriptive and comparative anatomical discussion and interpretation of a new order of invertebrates from the Pennsylvanian black shale. This new order, whose nearest relatives are the ratfishes, is of great importance in furthering our understanding of the relationships of the cartilagenous fish groups. Dr. Zangerl, a skilled anatomist and one of the few scientists in this country to employ the techniques of histology in paleontological work, is now studying the approximately twenty genera of sharks found in the Pennsylvanian black shale. He is also adjunct professor, Department of Anatomy, University of Illinois at Chicago Circle, and lecturer, Department of Geophysical Sciences, University of Chicago.

Dr. William Turnbull

Dr. Eugene S. Richardson, Jr., curator of fossil invertebrates since 1946, is currently studying and describing the fossil animals of the Coal Age concretions of the Mazon Creek area in Illinois. The area has yielded unusually well preserved fossils of evolutionary significance. The results of Dr. Richardson's research are being published in a continuing series of papers in the Museum's *Fieldiana: Geology.*

Although Dr. Richardson has, of course, made many field trips in the Mazon Creek area, he also relies on amateur collectors to unearth new specimens. He has examined 147 collections of amateurs in his search for Mazon Creek fossil material, and many of these collectors have donated specimens to the Museum.

Dr. Richardson's avocation is the Vanishing Press. Proprietor, typesetter, compositor, artist, and author, Dr. Richardson operates Vanishing Press solely for his own pleasure and that of his readers. Most of the slim volumes produced are humorous and many appear under the authorship of E. Scumas Rory, one of Dr. Richardson's favorite pen names.

Dr. Bertram Woodland and Mr. Rudy Chavez

Like Dr. Richardson, Dr. William Turnbull, associate curator of fossil mammals, also joined the Museum staff in 1946. He concentrates much of his research effort on Pleistocene and pre-Pleistocene Australian mammals; the latter he describes as "the biggest hole in our record of mammalian history." Now, after extensive field work, Dr. Turnbull and a colleague at the University of Texas, Dr. Ernest Lundelius, are piecing together the history of Australian fauna. They published on the Hamilton Fauna of the Grange Burn, Victoria, Australia in 1970 and now have in press a paper on the Madura Cave fauna of Australia. In collaboration with Dr. Frederick Schram, Eastern Illinois University, Dr. Turnbull is also publishing a paper on the pygmy possums of the Wombeyan Caves area, a late Pleistocene site in Australia. This summer will find Dr. Turnbull on a field trip to Washakie Basin in southwest Wyoming, where he has been collecting fossil mammals since 1956. Some of the specimens he has uncovered there date back to the mid- to late Eocene.

Dr. Bertram Woodland, curator of igneous and metamorphic petrology, was born in Wales and seems to have fallen heir to the Welshman's legendary gift for language. The Department of Geology receives many visitors seeking geological identifications and information. Like the other curators, Dr. Woodland takes time from his research work to help these people, explaining some basic geology, if required, and graciously cushioning disappointment when a visitor's "very unusual rock" turns out to be quite common.

Dr. Woodland is studying the origin and structure of rocks in both the Royalton area of Vermont and the Hill City area in the Black Hills of South Dakota. He is concerned with the geometry of microscopic and small-scale deformation structures of metamorphic rocks and their origins and relationships to larger-scale structures of the same region. Dr. Woodland is seeking to determine what forces produced the rock structures as they exist today. His report on his studies of the Vermont area will be published in the near future.

Dr. Woodland is also studying the genesis of concretionary structures, by analyzing and interpreting the primary structures preserved in these concretions and working out the relationship of the concretionary development to the decay of organic matter within fine sediments.

Dr. Edward Olsen, curator of mineralogy, joined the Museum staff in 1960. He is an authority on meteorites and meteoritical research and was recently awarded a NASA grant to study the chemistry of silicate minerals that occur in very minor amounts inside iron meteorites. These minerals have largely been ignored over the past fifty years, and Dr. Olsen believes they may yield valuable new information about the kind of planetary object from which iron meteorites came originally. At present there is no definite relationship known between the two main types of meteorite, the stones and the irons.

In addition to research work in conjunction with the Museum's extensive mineralogical collections, Dr. Olsen has analyzed Apollo 11 and 12 lunar rocks, co-authored the results with colleagues at the University of Chicago, and examined samples of material from all Apollo flights.

Over the years he has become interested in archeological problems in relation to ancient metallurgy, especially in the New World. Principally with Dr. Arnold Friedman of Argonne National Laboratory, he has published several papers on ancient metal technology.

Dr. Olsen also serves as adjunct professor, Department of Geological Science, University of Illinois at Chicago Circle, and guest researcher, Argonne National Laboratory.

Dr. John Clark, associate curator of sedimentary petrology since 1963, is presently concentrating on the geology of the western United States and will conduct field trips to South Dakota, Wyoming, and Colorado this year. Since 1932 he has been concerned with Oligocene paleogeography and paleoclimatology, studying the history of the development of climates, especially the relationship of past climatic patterns to those of the present and future. He believes that an understanding of the climatic conditions that existed prior to the Ice Age, which may be inferred from present geologic evidence, can enable us to predict major climatic changes to come. The publication in 1967 of "Oligocene Sedimentation, Stratigraphy, Paleoecology and Paleoclimatology in the Big Badlands of South Dakota" (*Fieldiana: Geology Memoirs,* Volume 5) summarized his research to that date and stands as a landmark in Dr. Clark's career.

Before joining the Museum staff Dr. Clark headed the Central Asiatic Research Foundation and through it operated a medical dispensary, three experimental gardens, and a geological survey and craft school in Central Asia. His experiences in Asia are recorded in his book *Hunza, Lost Kingdom of the Himalayas* (Funk and Wagnalls, 1956). He has served as a lecturer in the Geology Department, University of Chicago since 1963.

Dr. Edward Olsen

Mr. Orville Gilpin and Dr. John Clark

Dr. Matthew Nitecki

Dr. Matthew Nitecki, the newest member of the department's curatorial staff, was appointed assistant curator of fossil invertebrates in 1965 and became associate curator in 1968. His main research interest is Paleozoic fossils, particularly the lower groups of invertebrates and algae. To help make the evolutionary record more complete, Dr. Nitecki is working on the receptaculitids, problematic organisms that had been considered sponges but are, in fact, calcareous green algae. These algae existed during the Paleozoic period, over 500,000,000 years ago, and are significant to our understanding of the development of both plant and animal life. A monograph detailing Dr. Nitecki's findings regarding the North American receptaculitids will soon be published in the Museum's *Fieldiana* series.

Mrs. Katherine Krueger

Dr. Nitecki's research interests also include Upper Mississippian snails from the Illinois basin and the evolution, relationship, and morphology of calathiids from North America, Asia, and Australia.

Dr. Nitecki has been a lecturer at the University of Chicago Extension Division since 1961. His evident pleasure in his work is no doubt the reason his field trips to the Ozarks and the Grand Canyon for Museum Members are so successful.

Capable though they are, these seven men do not run the Department of Geology fourteen-handedly. Their research efforts are supported by six other staff people and ten volunteers.

Mr. John Harris

Orville Gilpin, chief preparator of fossils, plays an important role in the department. Mr. Gilpin came to the Museum in 1938 as a WPA worker and has developed through years of painstaking work the unique skills required to prepare fossils for study or exhibition. He has often devised his own tools to accomplish the time-consuming and delicate task of fossil preparation. He spent eighteen months scratching and scraping at rock with phonograph needles mounted in a metal handle before a Pennsylvanian shark was revealed in its wealth of detail. The construction of the huge dinosaur skeletons on display in Stanley Field Hall and the impressive Edaphosaurus and Dimetrodon skeletons in Hall 38 are spectacular examples of Mr. Gilpin's work.

Mr. Gilpin is also a good teacher. Schools do not offer courses in dinosaur-building or fossil preparation, and Mr. Gilpin has given on-the-job training in these techniques to many young people.

Mrs. Winifred Reinders

Mrs. Katherine Krueger, assistant in paleontology, joined the Museum staff in 1968, after receiving a master's degree in geology from Tulane University. She maintains the paleontology collections, catalogs incoming specimens, handles specimen loans, and serves as research assistant to the staff. She is also presently assisting Dr. Turnbull in a project to computerize the fossil mammal collection catalog.

Mr. John Harris joined the Museum staff as preparator in the Geology Department in 1969. In addition to preparing fossils, he is skilled in making fiberglass and plaster molds and casts, enabling the Museum to lend copies of specimens to other institutions. Some examples of Mr. Harris' work are the fine reproductions of artifacts from the Museum's famous collection of Benin bronzes in the Museum's traveling exhibit "Afro-American Style From the Design Works of Bedford-Stuyvesant" (at Malcolm X College until June 30).

Miss Jeannette Forster

Mr. Rudy Chavez is the newest member of the geology team, having joined the staff as assistant in petrology in 1970. After a short on-the-job training period he took on his present responsibilities of preparing rock specimens for study. This includes cutting, polishing, and making thin sections of rocks and fossils for microscopic study.

Completing the important support staff in the department are Mrs. Winifred Reinders, departmental secretary, and Miss Jeannette Forster, secretary.

Patricia M. Williams is managing editor of scientific publications, Field Museum.

CALENDAR

Exhibits

Continuing

Australian Aboriginal Art from Arnhem Land, a selection of nearly 400 bark paintings and wooden ceremonial sculptures. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit exploring the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through September 4. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. Continues indefinitely.

Morton Arboretum: 50th Anniversary, a small commemorative exhibit, featured in the South Lounge through June 4.

Hours

9 a.m. to 6 p.m. Saturday through Thursday; 9 a.m. to 9 p.m. Friday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410.

Free Film Program

Continuing

"Patterns for Survival" (A Study of Mimicry), presented at 2:15 p.m. Saturdays and Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

"Chinese Jade Carving," shown at 2 p.m. and 3:30 p.m. Saturdays and Sundays in the second floor North Meeting Room. The unusual short film serves as an excellent introduction to Field Museum's new Hall of Jades.

"Aborigines of the Sea Coast," offered at 1:30 p.m. and 3 p.m. Saturdays and Sundays in the second floor North Meeting Room. The film provides background information on Field Museum's "Australian Aboriginal Art from Arnhem Land" exhibit.

Children's Program

Through May 31

"Our Vanishing Wildlife," Spring Journey for Children, a free, self-guided tour focusing on animal species that face extinction, to help youngsters understand what is happening to them. All boys and girls who can read and write are welcome to participate in the activity. Journey sheets are available at Museum entrances.

Meetings

May 9: 8 p.m., Chicagoland Glider Council.

May 10: 7:30 p.m., Windy City Grotto, National Speleological Society.

May 21: 2 p.m., Chicago Shell Club.

Live Demonstration

May 17

Nigerian potter Ladi Kwali gives a pottery-making demonstration in the traditional manner at 1:30 p.m. in the James Simpson Theatre. The program includes a short film on the Pottery Training Center in Nigeria, slides, and a brief lecture on the potter's art in that country.

Coming in June

Begins June 1

"Exploring Our National Parks," Summer Journey for children, begins June 1. The free, self-guided tour honors the 100th anniversary of the establishment of Yellowstone, our first national park. Youngsters have an opportunity to become acquainted with various features of our national parks and monuments by following the Journey through Museum exhibit areas. Through August 31.

June 16

Members' Preview: a special showing of "Soviet Union: Arts and Crafts in Ancient Times and Today," 9 a.m. to 9 p.m., for members only.

Opens June 17

Soviet Union: Arts and Crafts in Ancient Times and Today, a collection of almost 2,000 objects representing the finest examples of artisanship from the country's leading museums. It is the largest show of its kind ever sent abroad by the Soviet Union and is being shown in its entirety for the first time at Field Museum. Almost 4,000 years of history are spanned in the selection of carvings, tapestries, icons, court treasures, jewelry, and gold and silver work, as well as contemporary porcelains, ceramics, and embroideries. The exhibit is part of the thirteen-year-old cultural exchange program between the U.S.S.R. and the U.S.A. Through July 13. Halls 18 and 19.

The Women's Board
of
Field Museum

invites you to

a dinner and preview
of

"Soviet Union: Arts and Crafts in Ancient Times and Today"

Thursday, June 15

reception at 6:30 p.m.
dinner at 7:30 p.m.
music and entertainment until 9:30 p.m.

dress is informal
tickets $20 per person

for reservations, write or call
the Women's Board office
922-9419

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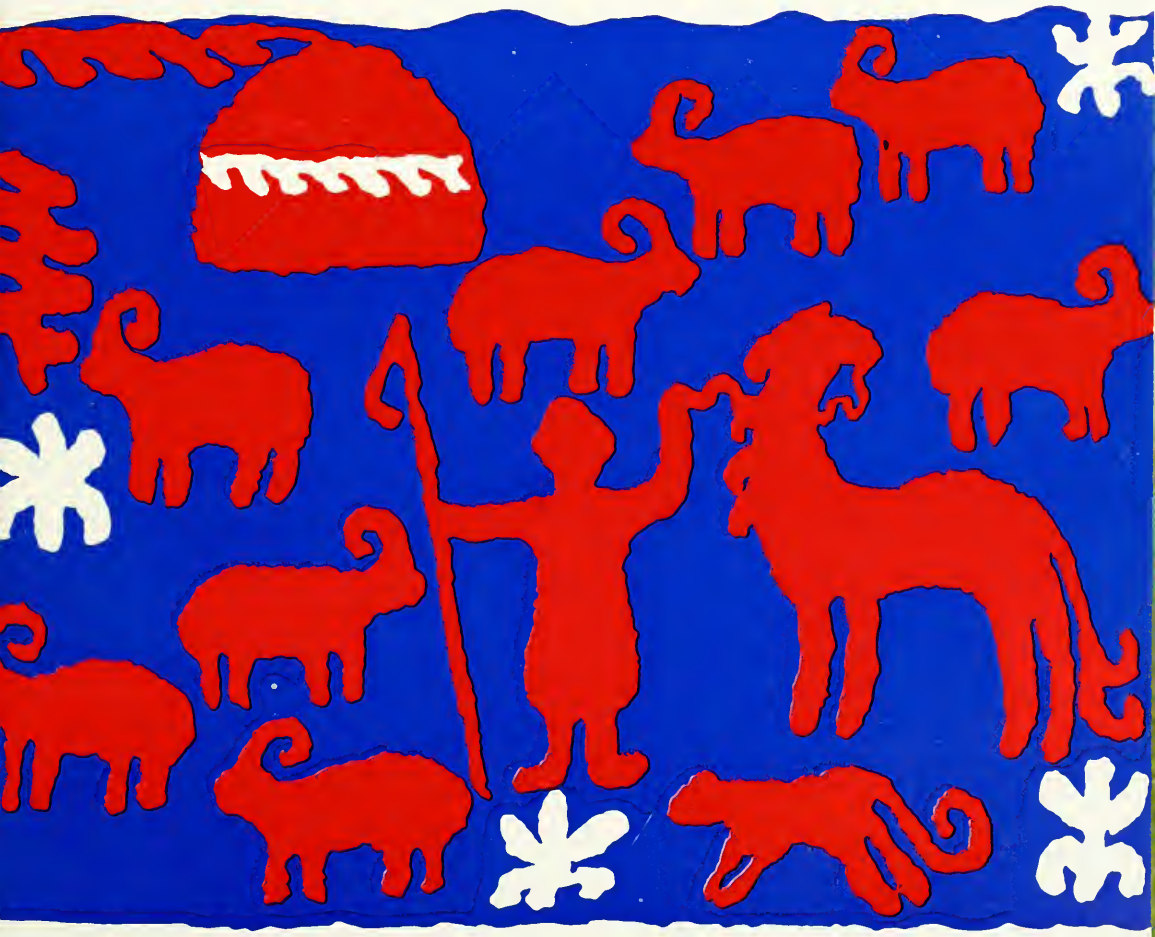

SOVIET UNION: ARTS & CRAFTS IN ANCIENT TIMES & TODAY

"Soviet Union: Arts and Crafts in Ancient Times and Today," on display at Field Museum June 17 through July 13, surveys the immense variety and richness of the folk arts of the diverse peoples that inhabit the huge land area of the U.S.S.R.

Since far back in the dim past man has felt a need to decorate and enhance even the simplest and most utilitarian objects that are a part of his daily existence. We call this form of expression, which is part of the customs and traditions of a culture, folk art.

Folk art has a way of revealing much more about a people than their history books. Since it is deeply rooted in the past, it is a means of preserving ancient themes, symbols, and forms, and perpetuating skills that have been gradually developed over the centuries. One value of folk art is its continuity, for it links one generation with the next. It retains what is esthetically most appreciated and most practical for everyday purposes, and it reflects outside influences and changes that occur within a culture as clearly as a written document.

More than one hundred national groups are represented in the fifteen republics that make up the Soviet Union, and each of them has its own customs, language, traditions, and characteristic arts.

Every piece in the exhibit has been carefully selected, for its beauty, for its appeal, and for the role it plays in telling the story of the origin and development of native arts and their present expression in the Soviet Union.

The sheer magnitude of the exhibit (almost 2,000 pieces) and broad scope (spanning 4,000 years, from 2000 B.C. to the present day) make it the largest and most important of its type ever sent abroad. The collection, which has been gathered from the major Soviet museums and art centers, is being shown in its entirety for the first time in this country at Field Museum. The showing is part of a cultural exchange program between the U.S.S.R. and the U.S.A.

This vast aggregation of material, modern and centuries-old, includes porcelains, glassware, majolica, carpets, tapestries, gold and silver work, ceramics, lace, wood carvings, sculpture, embroideries, tiles, and lacquer ware.

While the emphasis of the exhibit is on decorative and applied arts and crafts, striking examples of fine arts, jewelry, and religious articles are also included. Among these are Scythian artifacts dating from 500 B.C., icons from the 15th to 18th centuries, treasures of the tsars, and elaborately ornamented ecclesiastical garments.

The display is designed to acquaint Americans with the many different types of art in the U.S.S.R. Soviet art experts and English-speaking guides will be available during the entire showing to assist visitors and answer questions.

A special preview for Members of Field Museum will be held from 9 a.m. to 9 p.m. on Friday, June 16. Members will receive a special invitation in the mail shortly. Either the invitation or a Museum membership card will admit them to the preview, in Halls 18 and 19.
—by Madge Jacobs, Publicity Coordinator, Field Museum.

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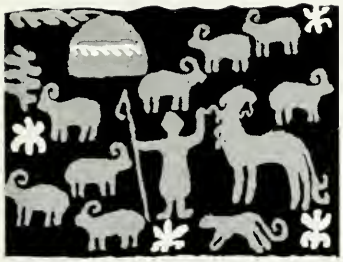

Cover: Detail from rug in exhibit "Soviet Union: Arts and Crafts in Ancient Times and Today"; contemporary; wool felt; by Jumabai Umetov; from State Museum of Fine Arts, Frunze, Kirghiz S.S.R

Soviet Union: Arts and Crafts in Ancient Times and Today
Madge Jacobs
an introduction to an extraordinary exhibit at Field Museum this month

2 **The Folk Art of Russia**
Sarah P. Burke
since the 18th century, changes in the old forms and designs of rustic village peasant art have both reflected and influenced taste and fashion of city dwellers

9 **Expedition into the U.S.S.R.**
Nancy Nadler
some human and scientific sidelights of a Soviet-American cooperative research project

12 **Politics and Archeology**
Bennet Bronson
the psychology and style of the contemporary archeologist need revolutionary change

16 **Members' Nights, 1972**
photos of some of the 7,715 people who came

16 **Capital Campaign**
a progress report on our $25,000,000 capital improvement campaign

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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Не то дорого, что красного золота,
а дорого, что доброго мастерства.

The Folk Art Of Russia

Sarah P. Burke

This month an extraordinary exhibition of ancient and modern arts and crafts from the Soviet Union opens at Field Museum. The exhibition brings together folk arts and crafts from all of the fifteen republics of the Soviet Union. Each of the republics has its own rich traditions of folk art.

Among the richest and most varied are the folk art traditions of the cultural and geographic area traditionally called Russia, which comprises most of the European part of the U.S.S.R. This discussion is limited to that area, although the objects in the exhibition represent the whole of the Soviet Union. Hence, the term "Russian" as used here should not be understood as all-inclusive.

The first motifs of Russian folk art were the ancient pre-Christian ones: for instance, the solar symbols, the swastika, horses, roosters, flowers, and grasses. They served as the basic motifs of this art until the eighteenth century, the time of the westernizing reforms of Peter the Great. When writers and artists became aware of the peasant arts in the twentieth century, they looked back with nostalgia to the pre-Petrine period as a time of pure folk art, unadulterated by Western European ideas and art forms. These earlier peasant art objects—most of what has survived dating only since the seventeenth century—are characterized by simplicity and grace in their designs. The designs varied from item to item but were primarily floral and covered the entire surface of the object. Their grace results, perhaps, from the fact that the artistic energy of the folk master was directed not to overcoming the material but to fashioning an object which closely tied together the possibilities of the material, the utility of the finished item, and the decoration.

After the seventeenth century, though the old forms and motifs are preserved, they appear in conjunction with new ones and take on a more purely decorative character. In the eighteenth century Peter the Great's reforms deepened the split between city and village. For all of the arts it was a time of infusion of Western European schools and styles. While these trends primarily affected the cities, they also reached the villages and influenced the peasant art. Under the influence of the baroque style, for example, the traditional plant designs that decorated folk objects became more complex and ornamented and the plants depicted became more realistic. Scenes from contemporary life began to appear on some objects but the depiction did not yet go beyond ornament; that is, the scenes still blended in naturally with the overall decoration. On many objects these newer motifs, in conjunction with the older ones, resulted in an engaging blending of fantasy and reality, a blend so characteristic of other forms of peasant art, such as the folk and epic tales. As new motifs came into Russian folk art they were manifest first in those things made by the folk masters for city dwellers, such as majolica, large copper bowls, and silver objects. Things made by the peasants for their own use retained the more traditional patterns.

The first half of the nineteenth century was marked by a flowering of Russian folk art, but the latter half was a period of crisis. With the rapid industrialization of the country, many of the peasant-made items were replaced by cheaper factory-made ones, and the country markets began to be flooded by factory-manufactured dishware, fabrics, and household implements. Art by the peasant for the peasant was gradually disappearing, and with it the rhythmic sense of design which had resulted from the craftsman's sense of balance between utility and decoration. Only in the most isolated regions of the Russian north was peasant art able to continue its natural development.

Whereas peasant art for the villages was disappearing, peasant art for the cities was thriving. It is ironic that city dwellers should have taken an interest in the folk tradesmen at this time, yet it is also understandable. At the end of the nineteenth century in Russia there was a reaction against the extreme rationalism and materialism of the preceding decades. People longed for the irrational, the primitive, the Rousseauistic type of existence. Ethnologists were just beginning to bring peasant art to the attention of society, which naturally seized upon it, however idealistically, for its qualities of naiveté and directness. This widened city market had important consequences for folk art, for now the design of an object was dictated by the tastes of the city buyer rather than by the craftsman's sense of an organic relationship to its function. The products of peasant workmanship were becoming souvenirs.

During this period one trend in design, noted in the eighteenth century, continued and was strengthened—the trend toward more realistic depictions of subjects. On certain objects, such as the painted papier-maché boxes, the designs were no longer part of the overall decorative pattern; they became sophisticated paintings with three-dimensional perspective which were valued independently of the object itself. Another trend in decoration at this time was to make the traditional designs more "folksy." Often the old folk designs did not correspond to the city dweller's image of peasant art, and the tradesmen therefore exaggerated the fantastic elements and accentuated the ornamental patterns, with a resultant stylization and even caricature of the original.

The crisis in Russian folk art did not go unnoticed, and there were attempts to revive and sustain the native traditions. Two of the most interesting and unique attempts were carried out at the art colonies Abramtsevo, outside of Moscow, and Talashkino, near Smolensk. The most creative artists of the time lived at these colonies and created works which were imitative of folk art. As artists they were interested primarily in design and looked back to the pre-Petrine period for their models. The results of their efforts were engagingly ornate, stylized art objects based on native art. Certain items of furniture, for example, had so much ornament that they were uncomfortable and nonfunctional. Some of the artists, especially at Talashkino, did strive for authenticity. Nevertheless, the importance of these colonies was not in their attempts to revive folk art but rather in the tremendous influence that native art through their works had on twentieth century Russian avant-garde art.

More practical attempts to sustain the folk tradition were made by local government organizations, which founded trade schools to teach and propagate the ancient designs and forms. One shortcoming of these institutions was that too often the directors of the schools and not the folk masters determined the designs to be followed. While these schools helped the folk artists to get through the difficult first decades of the twentieth century, they actually were neither creating nor continuing a tradition in a lasting sense.

Russian proverb: *An object made by the hand of a master craftsman is more valuable than one of precious gold.*

Photo: A mythological bird-siren *(alkonost)*, symbol of joy, in facade decoration of a peasant cottage; 19th century carved wood; Gorkii Region; State History Museum, Moscow.

Perhaps the most serious consequence of the industrialization of Russia was that peasants in increasing numbers were moving to the cities to work, and thanks to better forms of communication, the city was also moving more and more into the country. In Russia the distinction between city and country life was rapidly disappearing, so that after the beginning of the twentieth century only in a few remote areas did authentic folk culture and its distinctive art survive.

I will attempt now to give a general survey of the four main divisions of Russian folk art: woodworking (carving and painting), ceramics, metalworking, and decorative work on fabrics. All items of folk art cannot be covered, so I will limit my discussion by concentrating almost exclusively on those objects which were made by the folk masters for their own use as opposed to those made for the city markets. All the objects described were used in peasant households, and all, with few exceptions, died out in the first decades of the twentieth century, for reasons already suggested.

One of the oldest and most conservative forms of Russian folk art is wood carving. Wood was the most abundant natural resource in Russia. It was used for houses, churches, and household implements, and the Russian peasant decorated this wooden environment with carvings. His house, sleigh, furniture, grave marker, even his locks, were beautifully carved and sculpted.

The most impressive type of carving was the deep relief which decorated the exterior of peasant houses. Unfortunately, few of these carvings older than from the nineteenth century are extant. The peasant houses had a high pointed roof and the carving typically followed the contour of the roof just under the eaves at both ends and ran along the sides, thus encircling the house. Wooden cornices placed above the windows were also deeply carved, as were gateposts and fence posts. These carvings varied little in their basic design, which was a mythological creature looking out from between a floral pattern of curving leaves and buds. The figure, which always holds onto or is hooked onto the floral design, is an integral part of the design as a whole. A mythological bird-siren (in Russian, *alkonost*), the symbol of joy, is one of the most popular motifs. Other creatures commonly represented in this type of carving are the lion, often with a human mask, the horse, sometimes with a lion mask, the unicorn, and the siren-mermaid, which was an especially popular motif of house carvers along the Volga River. The Volga carvers were ship builders, and therefore adapted the dominant motif of ship decoration to their homes, a mermaid looking out from between waves.

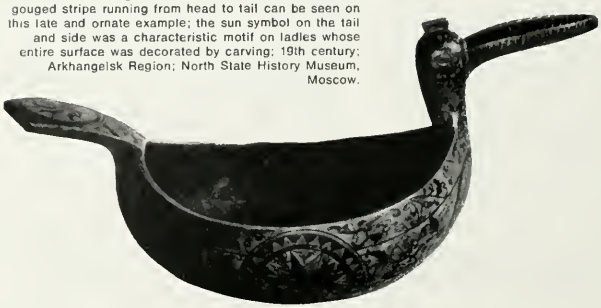
While this carving remained basically the same throughout the centuries, in the eighteenth century it did become more ornate under the influence of the luxuriant baroque interiors of city homes. It is sometimes forgotten that the village carving masters were the ones who worked on the construction of these interiors. The carvers both incorporated some of their own motifs into the interiors and adapted some of the baroque designs to their village carvings.

In the monumental carving, deep, coarse relief was characteristic, but on smaller items, flatness rather than relief was emphasized. The designs, which are often the same as on the houses, are much tighter and more geometrical than the larger carvings.

Some of the most ornately carved of the household objects were distaffs, or hand spindles. Spindles played an important role in peasant life and often two were kept in the house, one fancy and one plain, the former being handed down from generation to generation. The spinner would place the working spindle at her side with the bottom curved portion steadied under her leg. The wool or flax was loosely tied around the top paddle-like portion of the spindle, and the spinner pulled pieces of the raw material with one hand while spinning the thread onto a small top with the other.

Three basic styles are found among the carved spindles. The most traditional was characterized by geometrical motifs which covered the entire surface of the object. The ancient symbol of the sun, a circle with a rosette form within, is the dominant

Distaffs, or hand spindles, of carved and painted wood; 19th century; Vologda Region and Zaonezhie Region; North State History Museum, Moscow.



Kovsh-skopkar, carved and painted wooden ladle, in traditional bird shape, used for drinking beer or *kvas* or for wine-tasting; a remnant of the simple traditional gouged stripe running from head to tail can be seen on this late and ornate example; the sun symbol on the tail and side was a characteristic motif on ladles whose entire surface was decorated by carving; 19th century; Arkhangelsk Region; North State History Museum, Moscow.

geometrical motif and is frequently repeated on each section of the spindle. Spindles characteristic of the Iaroslav-Kostroma region also used geometrical motifs, but as secondary elements of the decoration. The primary elements are scenes from contemporary life, tea drinking being one of the most common. Depiction of such scenes became popular in the eighteenth and especially the nineteenth centuries. In the Nizhni-Novgorod (now Gorkii) region of Russia, spindles received quite a different treatment, under the influence of city life. In addition to the traditional carving, pieces of darker wood were inlaid to add variety to the designs and scenes from folk tales and noble life.

More traditionally decorated and one of the oldest of peasant household implements was the chiseled and carved ladle (in Russian, *kovsh*). Traditionally it was a bird-shape, but others evolved, such as a horse-shape, which often had multiple heads. The tail and bill were used as handles for drinking beer or *kvas* or, in the cities, for wine tasting. Such ladles were often richly decorated since they served as traditional gifts as well as decorations for holiday tables. A typical seventeenth century ladle was characterized by a simple design such as a flowing, broad, shallowly gouged stripe which ran from the head to the tail.

Another common carved item of Russian folk art was the fantastic gingerbread or cake board. These boards resemble rectangular trays which are covered with relief designs of emblems and contemporary and fairy-tale scenes. They were pressed onto cakes which were then given as special holiday or birthday gifts. The decorated cakes were often quite large, one of the largest being the gingerbread weighing around 150 pounds given Peter the Great when he was born. Although such boards were used in the country, they were carved primarily for the city dwellers, a fact which would explain the breadth of subjects depicted and the use of such emblems as the two-headed eagle.

Russian folk art was as rich in wooden sculpture as in carving. In the form of wooden toys, this sculpture flowered especially at the end of the nineteenth century and is one of the arts which has survived in the twentieth century. Folk-tale creatures and fairy-tale scenes are depicted, as are such real-life figures as barons and baronesses, soldiers, and wet nurses. A degree of irony can be noted in the expressions and dress of the real-life figures. The most famous toys are made even today, in Bogorodskoe village in the Moscow region. The masters of this village had long been known for their carving of bears and other animals; then at the end of the nineteenth century they began making the toys movable, which caused them to be even more well known. The toys from this village—bears dancing or beating a drum, squirrels playing basketball—are currently exported from the Soviet Union and can be found in stores in the United States.

Painting of objects arose much later in Russia than carving and sculpture, but it soon became a popular art form, reaching its height in the nineteenth century. The painted articles were originally done by the same craftsmen who decorated the cathedrals and icons, and on certain articles the influence of icon painting is evident. Painting allowed much more freedom of line and design than carving, and its introduction broadened the circle of themes which fed peasant art. In its most conservative form it reworked all the old symbolic motifs but with less conservatism than wood carving. At the same time, painting took new themes from everyday life, often combining them with the older motifs. As painting gained in popularity, it began to replace carving on many wooden articles, such as hand spindles, ladles, dishes, and boxes. The traditional colors used on these objects were mainly darker reds, greens, and browns. The paints were applied directly, without shading or mixing. As new pigments were developed, the color spectrum widened and much brighter colors were used in more subtle ways. But in spite of the striking colors, in Russian folk art the graphic element always dominates the color.

Glazed facade tiles for exterior decoration; design was carved into wooden blocks, which were pressed into the soft clay; 17th century; State History Museum, Moscow.

As in wood carving, the treatment of the graphic element on painted objects varied, and three main styles of painting can be distinguished. All three styles are well represented on painted spindles but can be found in other types of painted folk objects also.

The oldest and most conservative style kept to the more traditional designs. Of the two painted spindles pictured here, the one on the left is representative of this graphic style with its strong decorative cast. The motifs on this spindle are all ancient ones—the symbol of the tree of life at the bottom, the rooster in the middle, the flowering plant motif on the upper third. The spindle on the right is typical of a more subtle and refined type of painting which combines the older motifs with scenes from contemporary life. The sleigh scene in the middle third of the spindle is representative of this newer tendency in folk painting to show miniature

and realistic depictions, while in the upper and lower thirds are, respectively, the ancient bird-siren and sun symbols. The "realistic" portion is still part of the overall design and is in no way freestanding.

The third style of painting can be seen on hand spindles from the Nizhni-Novgorod region. Scenes from daily life are the main subjects and occupy the foremost place on the spindle—the larger, upper third. The painting is much more like easel painting than on the other two types, and, in fact, was influenced by nineteenth century easel painting. The most characteristic scene depicted, tea drinking, shows a table with two or more fashionably dressed persons seated behind it with drapery serving as a backdrop for the entire scene. Such two-dimensional depiction and drapery backdrop are reminiscent of icon painting. The influence of easel painting is represented by the painter's choice of subjects and use of color.

The Khokhloma wooden tableware, so well known in the West thanks to the revival of this craft in the Soviet Union, also comes from the Nizhni-Novgorod region. Although the designs found on the contemporary tableware are different and have a mechanical character, the basic plant motif and the traditional colors, red and black on gold, have been retained throughout the centuries. The process used to achieve the colors is an interesting one. After the object was carved it was coated with loam and then bathed in linseed oil. The next step was to give it several coats of varnish and cover the surface with a powdered silver metal suspended in water. Onto this silver surface the black and red design was painted, more varnish was applied, and then the object was fired. During the firing the silver background turns into a bright gold color. Present-day examples of this folk art can be widely found in the West.

Although ceramics was not so varied as woodworking, it was also a highly developed Russian folk art. On churches and on peasant houses could be found brightly colored ceramic relief tiles depicting folk-tale creatures, scenes from real life, or the traditional floral designs. The designs for such tiles were carved into wooden blocks, which were pressed into the soft red clay before it was glazed and fired. Another common type of ceramic tile, not in relief, was used to decorate peasant stoves. The stove was the most important part of the peasant house and usually stretched along

Ceramic toy, a peasant woman carrying buckets; clay is baked and then painted with tempera and gold leaf; contemporary; Dymkova Village, Kirov Region.

Drum-shaped bucket with cover, of painted birchbark; used for carrying such things as sour cream home from market; 19th century; Arkhangelsk Region; North State History Museum, Moscow

Typical large ceramic stove tiles, with fairy-tale motif; 17th-18th century; State History Museum, Moscow

Wrought iron candleholders, 47.4 and 49 inches high; 17th-18th century.

one wall like a long countertop. Such stoves were large enough to serve as sleeping quarters for some member of the household during the winter months. Large ceramic tiles with brightly colored designs and pictures painted under the glaze in the two-dimensional folk style decorated the sides of the stove.

Equally fanciful and colorful is the ceramic sculpture in the form of make-believe animals, ladies, soldiers, and other figures. These ceramic toys were made in a number of regions, but the most famous and most captivating ones came from the Viatskaia (now Kirov) region, from the village of Dymkova. This form of folk art survived the first decades of this century through the efforts of one craftswoman who preserved the tradition and passed it on to others. As a result, the production of these toys is now flourishing in the Soviet Union. The usual subjects of the toys are the traditional peasant figures: the wet nurse; a *skomorokh* (an old Russian traveling musician-dancer-juggler) riding a goat with trousers or a pig, a peasant woman carrying buckets. The figures are made of red clay which is first fired and then covered with a white wash on which the final colors are painted. In the nineteenth century the white background was achieved by dipping the fired object in a solution of chalk and milk.

Some of the most interesting examples of Russian folk art are to be found in metal work. Everyday household items made of metal were, not surprisingly, limited in number and use. The most common metal objects were the charming three-dimensional copper locks in the form of ducks, horses, centaurs, and other ancient animal motifs. The same motifs were used for copper combs and adornments for spindles, the most prevalent motif being the heads of two horses in silhouette.

By far the most elegant and strikingly simple of the metal household objects is the tall wrought iron candleholder which stands on the floor. They were forged by the village blacksmith always in the same pattern: a stylized flower supported by a slender stem which has intertwined leaves extending from it. In peasant households they were used to hold splints of wood which were burned instead of candles for light. The village blacksmith also forged ornate lattice-work locks and smaller versions of the candleholders for peasant homes.

Of all the Russian native arts, embroidery and needlework are the most conservative in their preservation of the oldest artistic motifs. Embroidered articles were found in every household and were closely associated with the folk holidays and ceremonies. This fact in part accounts for their traditional nature.

Ornate needlework always decorates the most traditional article of a peasant woman's clothes, her headdress. Headdresses were common to every region of Russia and varied in shape and design according to region. They were prized possessions of women and were handed down from generation to generation. The needlework on these articles resembles tapestry, with floral or geometric designs covering the entire surface. Metallic threads of silver and gold or silk threads were sewn in a raised pattern onto a background of velvet or silk. The most festive headdresses had river pearls and colored stones sewn onto them for a richer effect.

Embroidery with a basic red thread is the most characteristic and traditional type of stitching found on clothing, tablecloths, bedsheets, and towels. The most characteristic designs are geometrical, the swastika being the dominant motif. Animals, plants, and humans are all geometrically stylized and become part of the overall pattern. The variety found in the red-thread embroidery results from the many types of stitches used by the seamstress in executing the designs. Especially brilliant and fanciful is the red-thread stitching characteristic of the Olonets region, noted for depictions of fantastic animals onto which tiny pieces of brightly colored silk have been sewn.

Another type of needlework, in direct contrast to the bright colors of the Olonets embroidery, was the white-on-white weaving done in the Vologda region of Russia and found most often on bedsheets. This striking weaving differs from other Russian needlework not only by its use of white but also by its use of newer motifs, such as panorama scenes from country life or folk tales. A border of lace was often attached to these weavings, thus forming a second border on the article.

A discussion of fabrics would not be complete without mention of the type used for everyday clothing, for ordinary tablecloths, for curtains, for book covers, and even for flags. It was made from homespun or linen which was then stamped with carved, inked wooden blocks. The patterns covered the entire fabric and varied widely from the most traditional folklore and floral motifs to patterns which depicted contemporary scenes. In the seventeenth century, for instance, sirens, lions, and unicorns predominated, while in the eighteenth century horsemen and country scenes were more popular. In the nineteenth century the cheaper factory-woven and -printed fabrics gradually crowded out the block-printed ones.

A lace-maker in the Vologda Region, which is well known for its lace, both within and outside of the U.S.S.R.; her traditional headdress is embroidered in a geometric design.

Because so many of the native Russian folk arts, like the block-printed fabrics, have died out, the Soviet government has adopted a broad program for reviving them. The greatest success has been with those arts which were primarily decorative rather than utilitarian in function, such as ceramic and wooden toys and needlework. An important result of this program has been to give the Soviet population an appreciation for their folk traditions. Now, through the traveling exhibition of Soviet arts and crafts at Field Museum, the Chicago public also can see and appreciate these folk traditions.

All the examples of Russian folk art pictured here except the candleholders are among the almost 2,000 objects in the exhibit "Soviet Union: Arts and Crafts in Ancient Times and Today" on display at Field Museum in Halls 18 and 19 from June 17 through July 13.

Dr. Sarah P. Burke is a specialist in Russian literature and folk art.

Dr. Charles F. Nadler, a Field Museum research associate, together with Mrs. Nadler and their fifteen-year-old son Charles, Jr., spent six weeks in the Soviet Union last summer as part of the first scientific research project under the joint sponsorship of the Academy of Sciences of the U.S.S.R. and the U.S. National Academy of Sciences. The Soviet Academy of Sciences had invited Dr. Nadler, Associate Professor in the Department of Internal Medicine at Northwestern Medical School, and Dr. Robert S. Hoffmann, Professor of Systematics and Ecology at the University of Kansas, to participate in a comparative study of the evolution of Asian and North American mammals.

expedition into the USSR

nancy nadler

The purpose of our expedition in the U.S.S.R. last summer was to study chromosomes, proteins, and skull measurements of related Asian and North American species in an attempt to identify evolutionary differences between the species that have developed since the two continents were one land mass.

During four or five periods in the past several million years the Bering Sea was closed at the north by a broad "land bridge" connecting the North American and the Asian continents. Animals spread back and forth across this dry land connection but then evolved in isolation after Siberia and Alaska were separated by the waters of the Bering Strait.

So far, the studies have found that after 100,000 years of separation, a pair of related mammal species, Siberian long-tailed ground squirrels and the Columbian ground squirrel of western North America, have retained the same chromosome structure but differences have developed in the structure of blood serum proteins and skull form. In contrast, Arctic ground squirrels of northeastern Siberia and Alaska, separated for only 10,000 years, have not diverged with respect to these characteristics.

Our summer work was carried out in two phases, first in the field, then in the laboratory. Two weeks of field work were spent camping in the Altai Mountains, centering on the Kuraiskaya Steppe near Mongolia.

With Russian dictionaries, insulated underwear, mountain climbing boots, a small tent, sleeping bags, mittens, and khaki field clothes, we three Nadlers and Dr. Hoffmann arrived in Moscow in early June and were met by Nikolai N. Vorontsov. He started the expedition off on a cheerful spring-like note by presenting me with a bouquet of flowers.

Our destination was Akademgorodok, a "science town" on the outskirts of Novosibirsk, with a population of 40,000 people centered around a university and the many institutes of the Siberian Branch, Academy of Sciences of the U.S.S.R.

During the 1,900-mile flight from Moscow east to Novosibirsk in the western Siberian lowland, our Russian colleagues and hosts pointed out first the seemingly limitless and uninhabited lowland forests. We next passed over the wooded-steppe dotted with islands of birches, which resembled closely the woods of northern Wisconsin.

In Novosibirsk we were lodged in an attractive new hotel run by the Academy for visiting Soviet and foreign scientists. We met the other scientific collaborators, our soon-to-be camping companions, and spent the first few days planning the scientific and logistic aspects of the trip to the Altai. This was the first zoological expedition to the Kuraiskaya Steppe of the Altai in which Americans had participated since 1912, when Harvard University and the Smithsonian Institution sent an expedition. Reading the journal kept by the members of this expedition helped us plan what to take. As for food, only instant coffee was brought from the U.S.A.; everything else was supplied by our Soviet hosts.

We boarded a small Aeroflot plane and flew 150 miles to Barnaul. No commercial flight was available to continue that day, but soon Dr. Vorontsov obtained a bi-wing, one-engine, thirteen-seater and we all piled in for a one and a quarter hour flight to Gorno-Altaisk. Both towns are starting points for trips into the Altai.

A minibus had been sent ahead from Novosibirsk to meet us, accompanied by a truck for the equipment. In the bus we followed the turbulent and glacial-silt-laden Katun River eastward as it cut through larch- and pine-covered mountains similar to western Montana. The clear feeder streams and mountain lakes of this region are full of trout and grayling. Collective farms, consisting of a central administration building, barns, schools, and log houses with gaily decorated window borders (*nalichniki*) and shutters were seen every fifteen to thirty miles. Farms in the Altai are devoted to grain production, dairying, maral (elk) farming, and farther east to yak and

sheep herding. At the farms we bought fresh bread and butter. The delicious Russian bread had a slightly different flavor at each of the villages.

At the first campsite near the village of Shebalino the Russians put up a large new tent which we three Nadlers shared with Bob Hoffmann and a Russian biochemist, Rem I. Sukernik. The Russian sleeping bags were warm but heavy compared to our light weight down bags. The cots, folding tables, stools, and eating utensils they provided were similar to their American counterparts. The Russians' great enthusiasm for outdoor camping would make a ready market for the new light weight equipment that has become so popular in the U.S.A.

All the cooking was done by a Russian member of the expedition, who was originally trained as a pharmacist. The field menu was usually kasha or semolina (hot cereals) for breakfast, and for lunch we had cabbage soup with canned meat in it, along with bread, butter, jam, and occasionally an egg plant spread similar in consistency to applesauce called "egg plant caviar." Dinner, usually eaten at 9 or 10 p.m., when work had ended, was similar to lunch. Much of the cooking of stew, soup, and the like was done in large pails over an open fire.

The evening meal of the first night in the field was a festive occasion, topped by a bottle of vodka with many toasts. But we knew we were in Central Asia when we saw a herd of yaks wander by.

After a few days the truck was loaded, everyone got into the minibus, and we proceeded eastward toward the Mongolian border along the two-lane blacktop main highway. After surmounting two passes the road turned to gravel and driving was slower. The traffic in Siberia consists mainly of trucks and motorcycles, which often had sidecars. Beyond the town of Inya the mountains became progressively more arid. The Chuiskaya Steppe adjacent to Mongolia is characterized by a gravelly, desert-like valley surrounded by high mountains with many glaciers on their summits. Numerous marmots, ground squirrels, pikas (similar to rabbits), and a few feral Bactrian camels live on this steppe. Mongol horsemen were riding over the barren ground herding their sheep and yaks.

With not much wood or water available in this area, we had to backtrack a few miles to the Kuraiskaya Steppe to establish a working base. There a permanent camp with sleeping and laboratory tents was set up in a grove of larch trees near a stream. The expedition then settled down to collecting and studying the specimens.

The Altai Mountains are an ecologically varied mountain range between the wooded-steppe zone and the deserts of Middle and Central Asia. For centuries inhabitants of the Altai District and other nomad horsemen traversed these valleys and steppes while marching back and forth from Central Asia to eastern Europe and Russia. Excavations of frozen graves in this region dating back to 500 B.C. have yielded beautiful old rugs and art objects which are now on display in the State Museum in Leningrad—the Hermitage.

As the days went by, cultural differences faded and common problems and interests were discussed. French was the common language between Helena Vorontsov and me and Russian or German amongst the men, but often sentences were a combination of French, Russian, and English words. Camp chores are the same in any country and we all helped with them as well as with the laboratory work. Living together in the mountains, sharing the chores, and working for a mutual goal certainly brought friendship.

All of the 100 animals we collected were eventually prepared and tagged as museum specimens; some were taken back alive to Novosibirsk. There chromosome and biochemical comparisons were carried out in the modern and sophisticated research laboratories of the Institute of Cytology and Genetics.

A second and shorter field trip to the Buryat Republic was made for more specimens in July.

After the field trips we four Americans and the Vorontsov family were invited to join several Academicians from the Soviet Academy of Sciences, including the famous Professor Englehard, head of the Molecular Biological Institute in Moscow, for a two-day cruise on nearby Lake Baikal. It was on a Soviet oceanographic research ship that had been reserved to entertain the president of the East German Academy of Sciences, Dr. Mothes, and Mrs. Mothes.

Cruising on the lake allowed us to enjoy the beautiful surrounding mountains, and periodically the boat would stop to allow a walk in the woods or fish picnic on the beach.

Traditionally decorated log house along the road to Lake Baikal.

Charles Nadler, Jr.; Helena Vorontsov; Dr. Nikolai Vorontsov; driver Misha; Dr Robert Hoffmann; Nancy Nadler; Amelia Sergevna, who did the cooking; and the Vorontsovs' daughter Masha on a mountain pass in the Altai.

Lake Baikal is the oldest, deepest (more than a mile deep), and so far as volume of water is concerned, largest fresh water lake in the world. It has unique fauna with about 100 endemic species including an endemic seal that probably came up the Angara River. Baikal is the source of the Angara. The cleaning action of the fauna keeps the lake very clear, but just as Americans are concerned about their lakes, the Russians are also concerned about pollution hurting their unique lake. Research is being done at the Limnological Institute at Baikal so that standards for pollution control can be set and the effects of industrial wastes on the lake can be monitored.

We visited an unexcavated Neolithic camp site on the shore of the lake, and there Professor A. S. Rozhkov of our group found flint tools and potsherds. In the historical museum in Irkutsk were many descriptive exhibits of these and earlier paleolithic sites located in the Lake Baikal-Angara River region. Thus the visit to Baikal encompassed not only a pleasant two-day vacation on the lake but exposure to a diversified group of Russian scientists and a chance to observe museum techniques relevant to the history of the region.

Many festive meals with toasts to all were enjoyed by the travelers and, refreshed, the Nadlers and Hoffmann headed back to Novosibirsk. There long days were spent in the laboratory with Charles Jr. helping with the electrophoresis and I joining Helena Vorontsov in performing statistical comparisons of chromosome measurements from the Asian and North American ground squirrels.

The results of the summer culminated in the preparation of three manuscripts pertaining to the evolution of Asian and North American ground squirrels, marmots, and sheep. They will be joint publications of the Soviet and American scientists, and published in both Russian and English. Plans were laid for a continuation and expansion of the research during the summer of 1972 in the U.S.S.R. and 1973 in the U.S.A., when Dr. Vorontsov will visit Field Museum, Northwestern University, and the University of Kansas and do field work with Dr. Nadler and Dr. Hoffmann in the western United States.

Nancy Nadler is a member of the Women's Board of Field Museum, as well as a research assistant in the field to her husband, Dr. Charles F. Nadler.

Politics and Archeology

Bennet Bronson

Archeology in the post-imperial age

What I propose to discuss is a serious problem, so serious that it threatens to bring most foreign archeological work in most developing countries—that is, on two-thirds of the earth's surface—to a complete standstill. The problem has not as yet been much discussed, even among archeologists. In fact, as far as I know this is the first time it has been mentioned in print. Yet it is an important problem, and one by no means confined to archeologists. Very similar problems affect other specialists who do field work in underdeveloped nations: social anthropologists, naturalists, medical researchers, geographers, historians, economists, and so forth. But here I will talk only about archeologists, since I know more about them and since the problem affects them more acutely than most.

Once it was easy to go out and do field work—to perform an excavation—in a foreign country. It was especially easy when the country in question was located in the "Third World," in one of the archeologically important but economically undeveloped parts of Asia, Africa, or Latin America which in those days were official or *de facto* colonies. One had only to contact the nearest colonial administrator (or embassy official in countries that were theoretically independent) to get government permission to dig. Excavators did of course face difficulties even then, but the difficulties were economic and scientific rather than political. If the archeologist could raise the money and master the necessary scientific *expertise*, he could go and work almost anywhere, provided his own country was not actually at war with the country where he wished to excavate.

Lately, however, things have started to change. About a third of the world is completely closed to American archeologists. Another third is difficult to get permission to work in. And what is worse, these closed and semi-closed countries include many with whom America's political relations are friendly. It is no surprise to find American researchers having trouble getting into China, but what about Pakistan, or India, or numerous other Asian or African nations? Considering that their museums will receive most of the things the foreigners excavate, and that the foreigners' payroll will give the local economy a helpful boost, then why should these countries object to having them come? And why do they seem to be objecting more nowadays than they did ten or twenty years ago?

The export of antiquities

First of all, let me make clear what is *not* an issue: namely, local objections to archeologists digging up art treasures and taking them off to foreign museums. It is true that once upon a time archeologists were (or seemed to be to the natives of the places where they worked) glorified treasure-hunters, whose main purpose was to fill the museums back home with splendid and valuable objects from the past. To the more clear-sighted of the natives, such men as Schliemann and Layard must have seemed less great scholars than great thieves, looting quite openly under the thin cloak of scientific research and with the whole-hearted connivance of overawed local officials, foreign diplomats, and the armies of the Western colonial powers.

But those days are gone. The local officials are less easily bribable nowadays and the diplomats and armies are involved with other things than helping stock European and American museums. Moreover, the passing of colonialism has meant that the former colonies have enacted laws designed to protect their heritage. Most countries no longer permit the export of antiquities, except perhaps the kinds of antiquities (potsherds, stone tools, and the like) that have little intrinsic value. One does still find in a few places the institution known as "the division," whereby the foreign archeologist and representatives of the host country split the excavated objects between them. But even this is dying out: within the past year, at least two of the countries where the "the division" survived have passed laws requiring that *all* excavated objects be deposited in local museums.

So the issue is not exploitation in any material sense. Most archeologists who work in most countries have long ago stopped hoping or even wanting to take their finds back home with them. With a few lamentable exceptions, they feel that the things they excavate in country "X" are the property of the people of X, and that to take them away is morally equivalent to breaking up and exporting the shrines or monuments of their own nations.

I should perhaps say in passing that the argument still is heard, perhaps more in the mouths of art dealers than field archeologists, that taking monuments from country X is different from stealing monuments from the United States or Europe—that because the people of X do not appreciate their heritage (and indeed, in many developing countries, heritage-appreciation is sadly undeveloped as yet) and because they may not care for their monuments properly, they therefore do not *deserve* to keep them. This argument is the rationale used by collectors (and even some museums) when they buy antiquities they know to have been illegally excavated and smuggled out of the country where they were found. However, whether or not that argument is morally valid (my opinion is that it is not), it is beside the point. The American or European archeologist who hopes to work in country X or Y simply will not be allowed into that country if he shows signs of wanting to export what he excavates. He must at least act as though he holds the country's heritage in respect. And with the majority of modern archeologists, their attitude of respect is quite sincere.

But this still leaves us with the question of why archeologists are unpopular. To answer it, we must turn to the between-the-lines history of the discipline and consider, not the vision and dedication of the great scholars of the past and the lost civilizations they have discovered, but instead the psychology behind those discoveries: the attitudes of the men involved, the way they worked, and what they thought they were doing. Looked at in this light, there are three major types of archeologist.

Archeologist-spies

Fortunately not many archeologists work as spies nowadays. But that was not always so. Back at the beginning of the century a number of archeologists are known to have offered their services to their country as intelligence agents and to have used archeological expeditions, both false and real, as covers for military intelligence-gathering activities. Leonard Wooley's and T. E. Lawrence's work in the Sinai in 1914 is a distinguished example of the cover-expedition. A less well known case is that of Aurel Stein, the greatest of all explorer-archeologists, who spent almost twenty years in the early 1900s discovering unknown Central Asian civilizations and—an activity readers of *Kim* will recognize—mapping possible Russian invasion routes

into India. There are even, incredibly enough, fake cover expeditions: ones which claim to be doing important espionage work while actually doing archeological research. The only definite case of this happened quite recently when a publicity-conscious American excavator announced that routes mapped by his expedition were responsible for the success of the Israeli blitzkrieg in 1967. That he was exaggerating slightly—in these days of aerial photogrammetric mapping, ground surveying by amateurs is almost useless militarily—does not alter the fact that he *thought* of himself as a spy or that he thought by claiming he was a spy he could raise more money for future excavations. The man was a fool. By his actions he has seriously compromised the integrity of his profession in the eyes of many persons in that part of the world. Security-conscious nations can hardly be blamed for restricting or excluding foreign researchers when there is any likelihood that those researchers will turn out to be more interested in military secrets than in scientific ones.

Archeological neo-imperialists

Somewhat more common than the excavating espionage agent is the Ugly Archeologist. the field worker who, through natural aptitude or an old-fashioned style of training, preserves the characteristic attitudes of the days when most archeology was done in colonies by colonialists.

These neo-imperialist archeologists can be recognized by several distinctive hallmarks. One is the fact that their expeditions tend

to have large foreign staffs (twenty or even thirty people is not an unheard-of number) who take charge of all the white-collar work of the excavation—the supervising, recording, and analyzing of finds. The leaders of such expeditions recruit their staffs from their own or from other Western countries, perhaps because they feel that the local people are not capable of doing any of the expedition's tasks except the picking and shoveling.

From this we can deduce another hallmark: the typical neo-imperialist archeologist, or his expedition at least, is rich. The cost of importing and maintaining twenty Western staff members will usually reach three or four times the total cost of an equally large expedition which recruits most of its staff locally.

Still another of his hallmarks, and one not unconnected with his richness, is that he is influential in the host country—the country where he works. While other scientists may go to country X quite inconspicuously, entering, working, and leaving without making much of an impression on anyone except a few rural villagers, the neo-imperialist goes there as a VIP. He is friendly with his own country's ambassador (if a citizen of certain nations, he may, indeed, even hold diplomatic rank himself), he talks on equal terms with highly placed local officials, and in general he wields a good deal of influence. He also tends to be unpopular with his colleagues the local archeologists.

His unpopularity is in fact a consequence of his importance. The problem is that most of the native archeologists in a typical underdeveloped country work for the government in the national archeological service, a job that (a) tends to be quite low in the bureaucratic hierarchy, and (b) is concerned largely with enforcing governmental regulations by keeping an eye on foreign archeologists. The relationship between the foreigner and his local counterpart thus has a certain antagonism built into it anyway. The antagonism is greatly exacerbated, however, when the foreigner is a VIP.

A true story will illustrate what I mean. It happened a few years ago in a country we will call "X" (like all pseudonymous countries in this article) and involves a man named "Y," a scholar of international eminence. Now X is famous for producing a certain kind of very valuable ancient statue whose export is, naturally, forbidden by national law. Y is famous for his appreciation of art works, among other things, (including statues of the type in question), for his occasionally high-handed approach to niggling restrictions, and for his ability to become friendly with the right people, such as kings and presidents. The rest of the story can be guessed. One day several members of Y's expedition were discovered at the airport of X's capital city with their suitcases stuffed with contraband statues. The officials of the national archeological service were annoyed and attempted to have Y's excavation permit revoked. They stopped trying only when it became quite clear that to throw him out would cost them their jobs. So foreign archeologists in general, and archeologists of Y's nationality in particular, are not at present popular with their colleagues in X.

Admittedly, this example is a bit extreme. But the same sort of thing, on a less splendidly arrogant scale, is far from rare. A good many European and American archeologists are important people—archeology in times past was an aristocratic profession and still attracts more than its share of the rich and well-born. On the whole, very few non-Western archeologists are important people; they work in minor jobs in obscure and badly paid government departments. This fact alone drives in a wedge. The gap is widened by another fact: that many non-Western archeologists are poorly trained and may even not be too competent. Low pay and non-existent prestige are not the best inducements to attract the brightest university graduates into a profession. This is not to say that the Westerners are actually better archeologists—indeed, it seems to this observer that the average non-Western archeologist is as quick to learn and as intelligent as his average Western counterpart. But the point is, it makes both groups *think* the Westerners are better, and this means that the two relate to each other in quite an unsatisfactory way.

Ideally the relationship would be one of equal colleagues, with the foreigners having perhaps a slight edge with regard to knowledge of the latest scientific techniques and the host-country archeologists balancing the scale with their incomparably greater knowledge of local materials. This almost never happens, however, in the countries where neo-imperialist archeology

is the fashion. At best, the relationship is one of condescending teacher to unwilling pupil. At worst, the two groups are open enemies, the one regarding the other as incompetent flunkies of doubtful honesty and the second regarding the first as arrogant fools, also of doubtful honesty.

One of the practical disadvantages of this outcome—I will refrain from discussing the more idealistic disadvantages until later—is that it gets foreign archeologists thrown out of countries. The problem is that the local archeologists are capable of helping the foreigners in one very important way that the foreigners' highly placed friends cannot: they can act as informed local advocates to explain exactly what it is the foreigners are doing. Help of this kind is always needed. In any country, it eventually happens that some newspaper charges the foreigners with desecrating national shrines, or that a xenophobic politician accuses them of being spies. What happens next may well depend on who the foreigners have to defend them. If a sizable number of people at middle levels of the government structure —archeological officials, university teachers, and the like—have a stake in what they are doing, understand this, and are willing to advise them and speak out for them, then the foreigners may weather the storm, especially if they have kept a moderately low, inconspicuous profile during the time they have been in the country. But if their only real communication within the host country has been with ambassadors and high officials, they are likely to find themselves abandoned at the first hint of trouble. Their erstwhile friends, being in jobs where the replacement rate is extremely high, have their own political skins to think of and may not be too sure that the foreigners aren't spies in the first place—for they *do*, after all, spend a lot of time wandering around doing pointless things in militarily sensitive parts of the country. In order to continue working for long periods of time in any country, the foreigner must build a base of popular support.

Ordinary archeologists

The reader may be thinking, especially if he is an archeologist himself, that this is all very well but, really, most archeologists are not like that. The average overseas expedition director of our day and age is a fairly average man: politically innocent, uninflated with his own importance, sympathetic to the problems of other countries, and no more on hob-nobbing terms with ambassadors and princes than is the ordinary tourist. Yet he, the modern low-profile scholar, also gets thrown out, with almost as much frequency as the scholars of the old school. Isn't it possible that the nations of the Third World are simply

getting more and more xenophobic, and that it doesn't matter what attitude the foreigner has? The answers, I think, are that they aren't, and it does. Most modern scholars who work overseas have quite a wrong idea about where their responsibility lies.

The trouble is, they are *researchers*. Their self-image is that of a scientist, whose theoretical concern is with abstract knowledge and whose personal, practical concern is with (1) the prestige of disseminating that knowledge among his colleagues, (2) the money that derives from that prestige, and (3) the satisfaction that comes from solving an intellectual problem successfully. For many archeologists, the country they work in (even if the country is their own) is simply a place where an interesting problem exists. The whole point of doing the research is seen in terms of the situation back at the museum or university: the achieving of tenure, the getting of grants, and the preparation of articles that will amaze one's friends and confound one's enemies.

Understandably enough, however, most of these goals do not greatly interest the citizens of country X. The more educated of them (and even an astonishing number of the more uneducated) can appreciate the importance of scientific knowledge. But they can hardly be blamed for feeling that this particular kind of scientific knowledge has nothing to do with them. Maybe the researcher will have the courtesy to send copies of his articles and books back to X. But he will not send many of them, and what he does send, being written in academic prose and addressed to problems and controversies that have never been heard of in country X, will almost certainly be incomprehensible to the vast majority of people there. Moreover, the objects the researcher has excavated, which he has properly deposited in local museums before leaving the country, are not likely to be much more comprehensible than the books and articles: bags and bags of broken pottery and boxes of bones and shabby stone and metal tools, with scarcely a statue or gold ornament among them.

Perhaps such things are meaningful to the foreign researcher, but it takes a lot of explanation to make them understandable to the average, somewhat spottily trained, archeologist of country X, much less to the average lay Xian. And these explanations are never made; not once in the years I have been associated with archeology have I heard of any case where a modern, theoretically oriented researcher has managed to explain to anyone in the host country exactly what his research has been all about.

So, after the high-sounding talk about the advance of science is over, and after the foreigner has come, put everyone to a lot of trouble, and gone home again to become rich and famous, what is left behind in X, the host country? A small amount of money, a few reprints of incomprehensible articles, and a young mountain of excavated junk. It is not surprising that the archeologists and politicians of many Third World nations come to the conclusion that foreign researchers are more trouble than they are worth.

The ethics of the situation

So far we have been considering the behavior of foreign archeologists from a very practical point of view: what they do is unfortunate because it gets them excluded from the places where they want to work. But now let us put the argument on a somewhat more elevated plane, that of what the foreigners *should* do, whether practical or not.

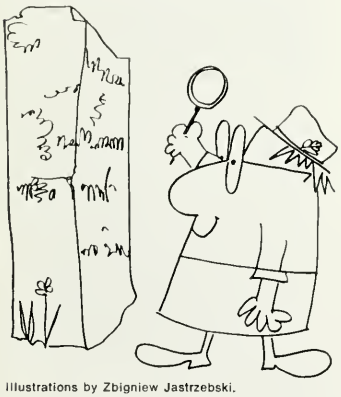
We need not spend long with the art thief, the spy, and the arrogant neo-imperialist. Everybody, or almost everybody, will agree that their behavior is ethically as well as practically indefensible. But this may not be so obvious in the case of the fourth type of archeologist, the honest, apolitical, humble researcher. What does *he* do that is unethical?

The problem is, rather, with what he does not do: he fails to communicate his findings to the people of the country he works in. That this has bad practical consequences has already been pointed out. However, one can make a good case for thinking it is also bad in an abstract sense, that it is a subtle but nasty form of exploitation, in its way every bit as cold and greedy, though not as profitable, as the activities of the old-time colonialist museum-fillers. The rationale for not bothering to communicate is that doing so is difficult. As I said earlier, nobody in the host country is likely to have the

training—and often no one even has the desire—to understand completely what the archeologists's research is all about. And it seems so impossible to break off one's research and give that training, that few archeologists would even consider trying. Yet, by not communicating, a great deal is lost.

One thing lost is the possibility of getting what the economists call a "multiplier effect" from one's research. A single foreign expedition can by itself accomplish very little, no matter how hard it works, by comparison with an expedition which has the intelligent cooperation of local people. Consider, for instance, the difference between Illinois and our mythical country, X. In Illinois, the excavator has a great many people helping him. There are perhaps twenty other excavations going on in any given year; any of the leaders of these expeditions and any of the perhaps five hundred students and other non-professionals who work on them may make discoveries that help an excavator understand what he himself has dug up. Moreover, the state contains thousands of other people—amateurs, scientists, collectors, farmers—who have useful knowledge about local archeological conditions.

By contrast, in X there is almost nobody. A few other foreigners may work there, and the country may contain a handful of government and university archeologists.



Illustrations by Zbigniew Jastrzebski.

mainly occupied with bureaucratic routine, along with a few wealthy collectors and mildly interested students. But otherwise, when the excavator has a problem there is nowhere he can turn for advice. The result is that research proceeds very slowly. From the standpoint of scientific progress, a year spent in training local archeologists and in promoting local interest in archeology would be at least as productive as a year spent in excavating.

Another reason for spending time on getting local people to understand one's discoveries is that, measured on any real scale of importance, those discoveries are far more important to them than to the people for whom archeological articles are usually written—a small group of archeologists back in the United States. After all, who here really cares that the ancient inhabitants of some exotic country invented the plough or started living in cities many thousands of years ago? Maybe a few American specialists will pay attention, but will anyone else? Can these facts possibly be as important to any American as they are, or could be, to the people whose own ancestors are involved?

One of the main justifications for spending money on archeology in the first place, in fact, is helping nations to understand their history. There is nothing idealistic about this. Knowledge of the past is the chief ingredient of a sense of national identity, and this in turn is a practical necessity for any country, particularly one which may have become a nation only recently. Mexico is a good example. Fifty years ago Mexican history, as it was taught then, began with Cortez and was exclusively the history of a small, Spanish-descended elite. The country was politically unstable; the Indian-descended majority of the population were dissatisfied with a system where Mexicanness excluded Indianness. But since then the situation has changed almost completely, largely due to the efforts of a small group of local artists and archeologists who were originally trained by and soon became the full equals of their foreign colleagues. Now Mexican schoolchildren are taught that Mexico is Indian and that its history is the history of the great Indian civilizations of the past, the Spanish conquest being just one episode in a sequence of important events that span more than five thousand years. The difference this has made to Mexico is incalculable. It has produced a new sense of national unity. The research and propaganda of a small group of archeologists, it could be argued, has done more for Mexico than a half-century of intensive economic development. It seems likely that properly oriented archeological programs in other places could have similar effects.

So, then, this business of communicating one's discoveries to local people is not just a question of avoiding getting thrown out of the country. Instead, it is a question of scientific effectiveness and general ethics. Does the archeologist have the *right* to come, dig, go home again, and eventually send back a few reprints? Doesn't he have a duty here, one that may be even more important than impressing his colleagues and pleasing his employers? Admittedly, there are some difficulties involved. Communicating one's discoveries within the host country can hardly be begun without spending a great deal of time training local archeologists, explaining to local administrators, and even putting out publicity via local media. And, admittedly, the system does not favor doing this. Few of one's colleagues will be impressed, and neither will one's employers or most agencies (the national and private foundations) that fund overseas research. With a few exceptions (including, incidentally, this Museum), the people whom archeologists work for are impatient with any overseas activity besides field work. They tend to think their employees spend an inordinate amount of time loafing around in expensive big-city hotels anyway, and often measure an employee's competence by the amount of time he actually spends in the field digging. Yet the employees should be spending time in the big cities. If the system is against it, then the system should be changed. It is quite clear that the way we are doing our research now is wrong.

Conclusion

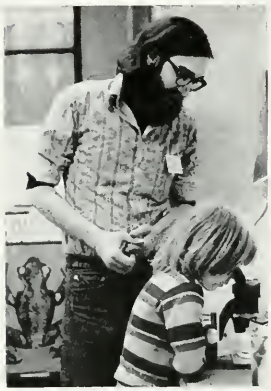
That, as clearly as I can state it, is what seems to me the problem. I have no complete solution. A first step is simply to acknowledge that a problem exists and to open it for discussion. This is what I have tried to do here. But to go further—to suggest programs, plans, ways of changing the present state of affairs—is most difficult. After all, what most needs changing is attitude. The researchers themselves, their employers, their backers, and the people of the countries they work in all have to be convinced, and this will be a lengthy process, even with the threat of a complete cessation of foreign fieldwork hanging over everyone's heads.

One possible approach is to set an example, by carrying out a research program that puts a heavy emphasis on training and communication. I myself am at the moment working at setting up a trial program of this kind, in Indonesia. But even if this works—and there are many political and economic obstacles in the way of such a program—it still will not be nearly enough. The necessary change in attitude can only be reached through extensive discussion, among archeologists and laymen alike. Among the laymen who can contribute most are those knowledgeable about foreign countries and interested in archeological matters—laymen like, for example, the Members of this Museum. I invite your concern.

Dr. Bennet Bronson is assistant curator of Asian archeology and anthropology at Field Museum.

MEMBERS' NIGHTS 1972

Photos by Fred Huysmans and Robert Natkin.



CAPITAL CAMPAIGN CAPITAL CAMPAIGN

Field Museum is pleased to announce that its $25,000,000 Capital Campaign launched in September of 1971 has reached the halfway mark. Gifts and pledges to the Museum through the generosity of individuals, corporations, and foundations total $6,355,000. These private funds will be matched with public funds through bonds issued by the Chicago Park District.

Of the total contributions to date, over $2,000,000 was received from corporations and foundations and nearly $4,000,000 came from individuals. The Museum is especially grateful to Standard Oil (Indiana) Foundation, whose gift of $500,000 got the Campaign off the ground. Other corporations and foundations which have contributed leadership gifts of $100,000 and over are: Chicago Community Trust, Continental Bank Charitable Foundation, Field Enterprises, Field Foundation of Illinois, Robert R. McCormick Charitable Trust, The Northern Trust Company, and Peoples Gas Company.

Under the leadership of Blaine J. Yarrington, president of American Oil Company, a solicitation team is being organized to call upon the Chicagoland business community. Proposals have already been made to certain major firms to secure pace-setting gifts. Future plans include calling on all Chicagoland business and industry. The individual gifts division co-chaired by Marshall Field and William H. Mitchell was given impetus by an anonymous gift of $1,000,000. An example of interest and support by the Trustees of Field Museum is represented by their gifts and pledges to date which total $1,625,000.

Plans are also under way for solicitation of members of Field Museum's Women's Board and other interested community leaders. Leadership gifts are needed from this source before the general solicitation of the Museum's overall membership is started.

Although we are "halfway there," the biggest job lies ahead, Capital Campaign Chairman Nicholas Galitzine noted. The Campaign leadership—Marshall Field, vice-chairman

and co-chairman of individual gifts with William H. Mitchell; and Blaine J. Yarrington, chairman of corporate gifts and philanthropic foundations—who have done so well for the Museum, said Galitzine, will need all the support they can get from Members, friends, businesses, and foundations. "It's an enormous task we have undertaken to put this 51-year-old building in good, modern condition. But the generous contributions received are an encouraging indication of the interest of all Chicago in helping further the research, exhibition, and education functions of the Museum as well as aiding in the preservation of more than 13 million natural history items for generations to come."

The Museum's need for a $25,000,000 Capital Campaign was outlined in the October 1971 *Field Museum of Natural History Bulletin*. Unlike most capital drives, the Museum's program is not an expansion effort. No new building is planned. No vast addition will be made to the Museum. The Campaign is not a frozen blueprint for several decades. Rather, monies received through the Campaign will be expended for vital renovations and improvements to Field Museum's present structure and facilities. Over the 51 years the Museum has been in its present location, innumerable maintenance, repair, and improvement efforts had to be postponed. Like a family that chooses college for the children over refurbishing its home, Field Museum allocated its financial resources to its scientific and education programs, not to its house.

It is interesting to note the concern which has been expressed by many leaders of our nation for the preservation of America's cultural treasures. President Nixon showed his concern for the future of our museums in a communication which he sent to the National Council on the Arts: "I am pleased to join with the Council," he said, "in urging action by the private and public sectors to safeguard our museum collections. Only by such action can we preserve our treasures for generations to come."

CALENDAR

Exhibits

Opens June 5

Chokwe Mask from Angola, on display in the South Lounge through September 10. One of the most beautiful of all Chokwe masks, it is called "Mwana Pwo," meaning young woman, and is worn by a male dancer at initiation and other important ceremonies.

Opens June 17

Soviet Union: Arts and Crafts in Ancient Times and Today, a collection of almost 2,000 objects representing the finest examples of artisanship from the country's leading museums. It is the largest show of its kind ever sent abroad by the Soviet Union and is being shown in its entirety for the first time at Field Museum. The exhibit is part of the thirteen-year-old cultural exchange program between the U.S.S.R. and the U.S.A. Through July 13. Halls 18 and 19.

Continuing

Australian Aboriginal Art: Arnhem Land, a selection of nearly 400 bark paintings and wooden ceremonial sculptures. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit exploring the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through September 4. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. Continues indefinitely.

June hours

9 a.m. to 6 p.m. Saturday through Thursday; 9 a.m. to 9 p.m. Friday. Beginning June 17 and continuing through September 3, the Museum will be open from 9 a.m. to 9 p.m. on Wednesday, Friday, Saturday, and Sunday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.
Museum telephone: 922-9410

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Free Film Program

"Chinese Jade Carving," a motion picture presentation, at 2:15 and 3:15 p.m. Saturday and Sunday, June 3 and 4, and June 10 and 11, in the second floor North Meeting Room. The unusual short film serves as an excellent introduction to Field Museum's new Hall of Jades.

"Aboriginal Arnhem Land," a motion picture presentation, at 1:30 and 2:30 p.m. Saturday and Sunday, June 3 and 4, 10 and 11, 17 and 18, and 24 and 25, in the second floor North Meeting Room. The film provides background information on Field Museum's "Australian Aboriginal Art: Arnhem Land" exhibit.

Children's Program

Begins June 1

Summer Journey for Children, "Exploring Our National Parks," a free, self-guiding tour honoring the 100th anniversary of the establishment of Yellowstone, our first national park. Youngsters have an opportunity to become acquainted with various features of our national parks and monuments by following the Journey through Museum exhibit areas. All boys and girls who can read and write may participate in the program. Journey sheets are available at Museum entrances. Through August 31.

Special Events

June 15

A dinner and preview of "Soviet Union: Arts and Crafts in Ancient Times and Today," sponsored by the Women's Board of Field Museum. For reservations call 922-9419.

June 16

Members' Preview: a special showing of "Soviet Union: Arts and Crafts in Ancient Times and Today," 9 a.m. to 9 p.m.

Erratum: In some copies of the May issue of the *Bulletin* there is an error on page 13 in the Geologic Time chart—the Triassic Period is transposed; it should be below the Jurassic.

Volume 43, Number 7
July/August 1972

Field Museum of Natural History Bulletin

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Cover: a threatened species going, going, gone? Design by Clifford Abrams.

2 Endangered and Disappearing Animals
Melvin A. Traylor
some threatened species, unable to withstand super-predator man, may disappear like the Dodo

5 Some Approaches and Methods in Comparative Anatomy
Karl F. Liem
discovering the "why" and "how" as well as the "what" of animal structures

8 An Ecological Dilemma—Our National Parks
Albert W. Forslev
can we enjoy our national parks without destroying them?

13 The World is Our Study
Alan Solem
a look at the past and a glimpse of the future of Field Museum's Zoology Department

17 Twelve Men to Learning Much Inclined
Elizabeth Munger
thumbnail sketches of some of the zoologists at Field Museum

20 Field Briefs

Calendar

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Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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endangered and disappearing animals

melvin a. traylor

Photo by Harold M. Mayer

As custodians of systematic collections that ideally will contain representatives of all the known species of animals, the staff of the Zoology Department are acutely aware of the many species that have become extinct in historical times, or that are now rare or endangered. It is not that extinction is a new phenomenon. Evolution and extinction are almost as much characteristics of species as birth and death are characteristics of individuals. But the rate of extinction has become so accelerated with the advent of modern man that there is a real fear that whole faunas may disappear before their very existence is known to science.

Although natural extinction is a commonplace, as witness the disappearance of the dinosaurs, it is such a gradual process that recognizing an example in the field is difficult. We can, however, recognize certain factors that make a species vulnerable. The most important factors are a restricted range and a high degree of specialization to a particular habitat, without the ability to adapt to change. The restricted range puts the species at the mercy of a natural disaster. For example, whatever species of land snails were confined to the island of Krakatau (between Sumatra and Java) were quite literally blown away in the explosion of that island, and only those that were more widespread survived to repopulate it later. Kirtland's Warbler is an example of a highly specialized species that is successful in its individual niche but will disappear when the habitat does. It will nest only under Christmas-tree sized jack-pines that have grown up after a recent burn. A prolonged wet spell of several years might eliminate this habitat, and the warbler with it.

The same factors that make a species prone to natural extinction make it vulnerable to man. Over 93% of the birds extirpated in historic times have been island forms. Within their limited range, they have been beautifully adapted to their special environments and highly successful, but their inability to adapt to a new man-made environment or to move elsewhere spelled their doom.

When I speak of "natural" extinction as opposed to "unnatural," caused by man and his civilization, I am making a distinction that is a little furry around the edges. Man has been a predator throughout his evolution, and as such has always had an impact on the animals around him. We like to think of the North American Indians as living in harmony with their environment, not putting more pressure on the native fauna than it could safely bear. And so they were at the time of the arrival of Columbus; but it was not the same Pleistocene fauna that had greeted the ancestors of these Indians when they arrived from Asia some 25,000 years before. At that time great herds of horses and camels ranged the central plains of North America, and mastodons and ground sloths still survived, as did many of the old predators like the saber-toothed tiger and the short-faced bear. Man, with his stone axes and spear points, was the super-predator on all these, and none was able to survive his coming. The balance between the Indian and nature was achieved through a drastic type of natural selection, much accelerated because of man's arrival full-blown rather than through gradual evolution. Only in Africa, where man evolved along with the rest of the fauna, were the Pleistocene animals adapted to him and able to survive.

Modern man is still a predator, and on a much larger scale. The interaction between his civilization and the non-human world is partly the continuing process of selection that will lead to a new balance between them. However, in our Western culture a new element has been introduced that has fundamentally changed man's view of nature: it is the ethic that sets him apart and pits him against nature as an antagonist. The Judeo-Christian belief that the world was created for man's use and enjoyment has been perverted to the feeling that nature is our enemy and must be broken to our will; that man was a creation apart and stands in opposition to the rest of the world. Our literature abounds with references to "conquering" nature, "subduing" the wilderness, "taming" the rivers, "wiping out" the vermin. In the New World particularly, subjugation of a whole continent was our avowed aim. Only in the past few decades has the role of man as a part of the natural world begun to find acceptance, and have concerned individuals begun to take stock of the havoc that man has wrought.

Primitive man accomplished his extirpations with a stone axe and spear. Modern man has added to this arsenal a conscious will toward conquest as well as a variegated array of much more devastating weapons—modern firearms and transportation, axes and chain saws, the plow, cities, factories and their pollution, pesticides, domestic animals, pets, his ubiquitous commensal the rat, and other introduced animals. Each of these has at some time or place seriously endangered or exterminated some species, and the process is even now accelerating. In the less than 300 years since that epitome of extinction the last Dodo died, 106 species and subspecies of birds and 40 species of mammals are known to have been extirpated, and today the Red Books of the International Union for the Conservation of Nature list 191 birds and 161 mammals as endangered. Taken together, these figures represent roughly 3.5% of the known birds and 5% of the mammals, a frightening rate in view of the tens of thousands of years needed for a new species to evolve.

But man seldom sets out deliberately to exterminate an animal. Those that he does are usually a health menace or agricultural pest or a competitor which he feels he cannot tolerate, such as the wolf or golden eagle. Most of the larger animals on which man is a direct predator with his guns and traps become endangered because he hunts them, either through ignorance or greed, far beyond the point at which the remaining population can replace the individuals that are taken. We can see this now in the serious depletion of the various spotted cats—leopards and cheetahs—and of the crocodiles and alligators, all hunted at the whim of fashion. Even more spectacular, though less well known, is the drastic reduction in the whale populations of the world. With the coming of the bomb-harpoon and small steam-chasers, and more recently the factory-ship which enables the chasers to remain at sea indefinitely, the odds against the whales became too great. First the Right Whales of the northern seas were hunted to the point where there was no commercial return; then in the Antarctic seas the Blue Whale, Humpback, Pygmy Blue, and Fin Whale were each decimated in turn. The last remaining commercially valuable whale, the Sei, was then attacked, and over a third of the remaining stock was taken for two years running. The International Whaling Commission finally stepped in and set realistic quotas, but whether the action was soon enough to save the endangered species will not be known for some time. The tragedy is not only in the loss of magnificent animals, but in the waste of a valuable resource. If only 10% or 15% of the original herds had been cropped each year, we would still be reaping a liberal harvest of meat and oil for hungry peoples.

Although we are most aware of direct exploitation of the larger mammals and birds, either commercially or for sport, many more species are endangered merely as a by-product of man's activities. Foremost among these activities are the destruction of forests for lumber or agriculture and the plowing of virgin prairies for farming. The magnificent beech forests of the Ohio valley, so continuous that "a squirrel could travel from the Mississippi to Pittsburgh without setting foot on the ground," are gone except for a few carefully protected remnants, and with them went the ecosystem of organisms dependent upon them. A spectacular example of a species endangered by the destruction of virgin forest is the Ivory-billed Woodpecker, the

largest of our woodpeckers. Unlike its more adaptable cousin, the Pileated, the Ivory-bill must have extensive stands of virgin timber to survive. Consequently it is now restricted, in very small numbers, to the cypress forests of east Texas and western Louisiana, and possibly Florida. If these forests go, the bird goes with them.

If the birds of continental areas are vulnerable to change of habitat and the pressures of man, those of small islands are much more so. Evolution of island species in harmony with their environment often means that in the absence of predators they lose the wariness or weapons that protected them on the mainland. They are defenseless when new enemies are introduced. Island birds must cope not only with the changing environment when man arrives, but with his invariable commensal the rat, which plays havoc with the endemic terrestrial animals. Man may more deliberately introduce goats or pigs or rabbits, all destructive of the vegetation, and often directly predatory on the local fauna. A measure of the destructiveness of this combination is found in the Mascarene Islands east of Madagascar. Besides the Dodo, there were 27 species of birds found only in this archipelago; 24 are now extinct, and the remainder survive only in small numbers in scattered remnants of mountain forest.

The weapon of man's final assault against the environment, one which directly endangers himself as well as the wildlife, is the pollution caused by his cities and factories and pesticides. For evidence of its force we need not go beyond the newspapers' daily listings of levels of air pollutants, which frequently exceed the "safe" levels, or announcements that beaches are closed because of filth in the water. The effects of water pollutants have been building up for decades, as witness the slow death of Lake Erie, but only within the last decade have the effects of persistent pesticides been apparent. The extirpation of the Peregrine Falcon as a breeding bird in the eastern states first showed how the pesticides accumulate to dangerous levels in large predators, and now that we are alerted we realize how widespread this phenomenon has become. Since man is the ultimate predator, this danger points directly to him.

What is the role of Field Museum's Zoology Department staff in the face of this accelerating deterioration of our world? Besides our humanistic obligations as individuals to try to pass on to succeeding generations as much of the natural world as possible, we have a special obligation as biologists to preserve examples of all forms of life and a knowledge of the way they live. The mere fact that we are able to discuss extinct species shows that our predecessors succeeded in collecting at least one example of each, and in many cases of island forms a single specimen 150 years old may represent our only knowledge of the organism. Of those that became extinct before a specimen was preserved, we have no knowledge. Since this is true of easily observed and studied animals like birds and mammals, it is vastly more so of the insects and mollusks and other "insignificant" groups. As Dr. Solem pointed out in an earlier issue of the *Bulletin* (April 1970), 10,000 species of mollusks may have been exterminated without the world being aware of them. Even when they are aware, the public will always be more concerned about the population of the Whooping Crane than about the hundreds of species of land snails that are lost when a section of the Everglades is drained. Yet it is probable that study of these snails can tell us more about speciation and ecology than study of any single species of bird, no matter how spectacular it is. In fact, parasites—the lice and mites and roundworms that were specific to an extinct host—may be of more biological interest than the host itself. Often the parasites can give good clues to the phylogenetic relationship of the host, but that is possible only if the host species continues to exist; when it dies out, it carries its parasites with it. Ornithologists would dearly love to have the bird-lice from a Dodo, to gain some hint of the pigeon from which it evolved.

The author discusses with Roy Steinbach areas in Bolivia where the Steinbach family will make collections.

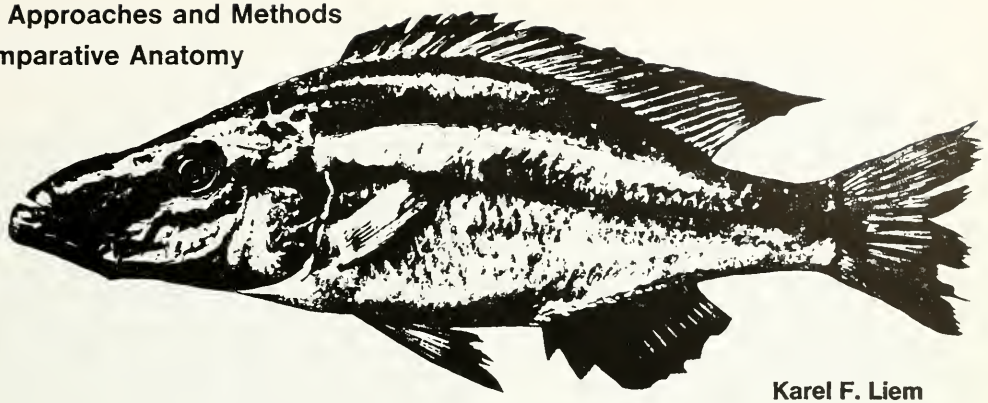
Our concern as scientists, therefore, is with whole faunas and their ecology as well as with individual species. This does not mean that we are not anxious to obtain specimens of endangered forms, for they will be the only permanent record of species if they are extirpated. We would not, however, put further pressure on a species by rushing out to collect more specimens just because we believe it will become extinct; this would help to make the prophecy self-fulfilling. Specimens should come from zoo animals or accidental deaths, such as the road-killed red wolf we recently received, one of our rarer North American mammals. Our scientific explorations should concentrate effort on endangered habitats and the whole faunas that are dependent on them. Many of these are in the tropical regions of Africa and the New World, where the developing countries look upon their forests as expendable resources. In Africa many of the mountains have montane forests on the upper slopes, isolated from each other, like islands in a tropical sea. Each of these forests has a rich endemic fauna that should be studied *now* while the animals are still abundant. If we wait until destructive exploitation of the forest for lumber or charcoal or agriculture has already threatened the animals, the original ecology will be too far gone to study.

The same situation prevails on the eastern slopes of the Andes in South America, where the forests are being destroyed for resettlement projects. This is an area of particular interest to many of our curators, and we are now initiating a program in Bolivia to make a faunal survey of the eastern forest region. Collecting will be done by the Steinbach family of Cochabamba, the third generation of which is now involved in scientific exploration. All major groups of animals—mammals, birds, amphibians and reptiles, fish, insects, and mollusks—will be sampled, as well as their parasites. Botanical collections will also be made so we will have a habitat in which to frame our creatures. We hope we will be able to develop a comprehensive picture of a tropical fauna, before the ecology has been distorted by man's activities.

As biologists, we are interested in natural history for its own sake, and would study our birds and snails and parasites whether they were endangered or not or in any way involved in man's economy. But we do not live or work in a vacuum. Knowledge of ecology—the interrelations of organisms and their environment—can be a weapon to oppose the type of thoughtless destruction that has gone on in the past. Our mechanized, industrialized civilization cannot reverse itself. Even if the size of the human population of the world were to stabilize today, we would still have to seek new food sources to adequately feed everyone. What seems to us wanton destruction of tropical forests is actually a desperate, if short-sighted, effort to meet the immediate needs of undernourished people. What we must do is use our knowledge to plan our future activities so that we do not take more from nature than she can renew—so we can hand on to the future a balanced world rather than a disintegrating one.

Melvin A. Traylor is Associate Curator, Division of Birds, Field Museum.

Some Approaches and Methods in Comparative Anatomy



Karel F. Liem

For many years comparative anatomists have been describing the various structures of animals in varying degrees of detail. One thing they discovered was that there is a common structural plan, at least among the animals with a backbone (vertebrates). For example, all vertebrates possess a backbone, skull, chambered heart, pair of kidneys, brain with three primary divisions, etc. Most comparative anatomists have been describing the variations in this structural plan. Even nowadays, many anatomists are producing nothing else but ever greater refinement of the details of the vertebrate structural plan, using, among other techniques, the electron microscope. While describing the variations in the basic structural plan, the majority of comparative anatomists have been trying to discover the history, or phylogeny, of the structural elements of the animal body.

In recent years several workers have developed new concepts in comparative anatomy. They maintain that the goals of comparative anatomy should not only be to *describe* but also to *explain* the structural variations among animals. In other words, anatomy should be concerned not only with the "what" but also with the "why" and "how" of the structures of animals.

There is delinitive proof that evolutionary changes are based on the interplay of random hereditary or genetic changes and the complex of factors in the environment. The creative evolutionary force is natural selection, since the environment will select which of the random hereditary changes will survive in nature. As an anatomist, I am interested not merely in recording the fact of evolutionary change but in analyzing the meaning and mechanism whereby the changes have been achieved.

I have chosen to study the comparative anatomy of the perch-like fish family Cichlidae in Lake Tanganyika and Lake Nyasa in the African Rift Valley (the Jack Dempsey, discus, oscar, and angelfish are familiar South American examples of this family). In both of these lakes the fauna is dominated by a large number of closely related species of cichlid fishes which have evolved within each lake basin and which now exploit virtually every way of life. "Explosive evolution" (very rapid evolution of numerous closely related forms in a circumscribed geographical area) has produced in each lake a high percentage of endemic species—that is, species which are found nowhere else in the world. Lake Nyasa, for example, contains more than 200 endemic species.

The "what" of structures

It is in their feeding habits that the cichlids have evolved astonishingly unusual adaptations. As a consequence almost every food source in the lakes is exploited. There are, for instance, numerous silvery-bodied species which feed on the minute animals of the plankton. Others collect and crack open the shells of clams and snails to expose their succulent contents. Still others graze on rooted plants, rather like cows! Again, there are species that live on the sandy shores and dig for midge larvae in the sand, while related species on rocky shores feed by rasping the film of algae from rock surfaces. Everywhere there are species that prey on the smaller ones. It has been reported that one species bites out the eyes of other fishes. Perhaps the most bizarre feeding method is the remarkable habit of scraping scales from other fishes. Within the stomach of the scale-eating species the scales lie in packets, and as they proceed down the intestine they become more and more eroded until only a mass of silvery granules remains. This scale-eating species intermingles with a shoal of a particular species of *Tilapia*, which does not suspect any enemy activity, since the scale-eating predator mimics the victims in body shape and color pattern. The fishermen are well aware of the presence of this scale-eating species in the shoals of *Tilapia*. They call it "Boss" because of the way it harasses the other fish.

Correlated with this great diversity in feeding habits are adaptations in dentition, jaw and skull forms, and the muscles operating the jaws.

The least specialized species are those that feed on insect larvae. They closely resemble the insect-larvae-eating species that inhabit the rivers of Africa, and they are considered to be the modern representatives of the species which existed before the great East African lakes were formed. Insect-larvae-eating species possess three rows of teeth on their jaws. Teeth of the outer row have two cusps while those of the two inner rows have three cusps. Most fishes have two sets of jaws. The first set is comparable to our jaws, while the second set is located in the throat (or pharynx) and plays an extremely important role in preparing and transporting the food toward the gullet (esophagus).

In the snail- and clam-crusher, the teeth of the pharyngeal (throat) jaws have differentiated into a powerful mill capable of crushing shells.

The scale-eating species possesses increased rows of file-like teeth in the first set of jaws to rasp off the small scales which cover the tail fin and adjacent parts of their prey.

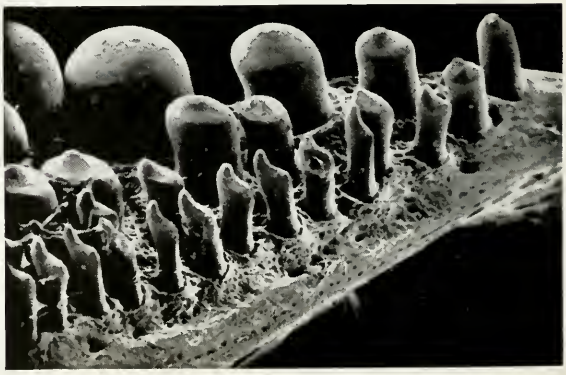
Numerous differences are found in the jaws, the skulls, the muscles operating the jaws, and the gill covers.

The "how" of the structures

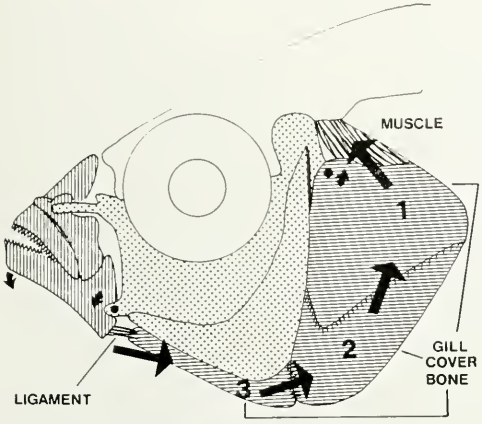
It is important to understand *how* these peculiar adaptations function. The jaws are operated by muscles and ligaments. It has been discovered that one way to open the jaws is by contraction of a muscle running between the skull and upper border of the gill cover. The muscle lifts the first upper gill cover bone, which in turn pulls the second and third gill cover bones. The third bone pulls down the lower jaw, and the mouth opens. Between all gill cover bones and the lower jaw are ligaments which transmit the movements of one bone to the other. Fish which prey on other fish have relatively long jaws and modified, smaller gill covers to increase the speed of jaw opening. Other species, on the other hand, may need to suck water into the mouth and through the gills in order to collect the small organisms in the water. Such fish possess smaller jaws, but have enlarged gill covers, which function as a suction pump. Many specializations occur also in the muscles operating the two sets of jaws.

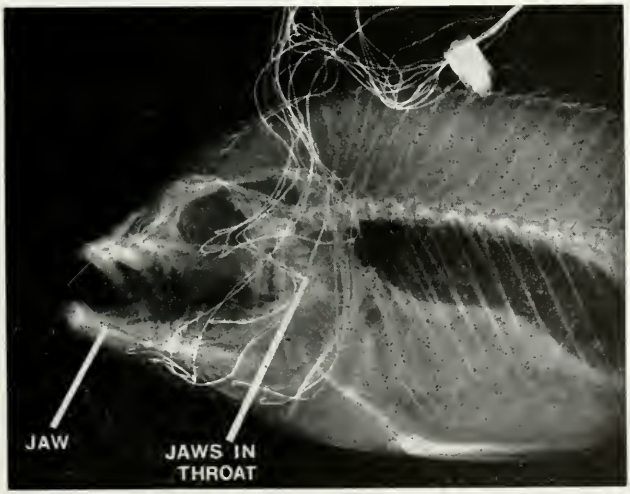
The best method of analyzing muscle function is electromyography. When a muscle contracts, it produces minute electrical activity (between 7 and 100 microvolts). These minute electrical signals can be picked up by tiny electrodes inserted in various muscles of the fish. The very weak electrical signals running through the electrodes are fed into preamplifiers and amplifiers which amplify the signals to such a great extent that they can be visualized on the screen of an oscilloscope or recorded on paper by the recorder. Records of several muscles can be obtained simultaneously from a fish which swims around breathing and feeding naturally.

By using these methods I hope to unravel the functions of the numerous highly specialized adaptations and to explain *how* these specializations have evolved. I will also try to explain *how* various structures depend on each other. In medicine it is known that when a surgeon removes or modifies an organ or structure many changes occur in neighboring organs or structures. Similar events occur in evolution. An evolutionary change in one structure will bring about changes in other structures, not unlike a chain reaction. For example, the gill covers of most fishes function in both breathing and operation of the jaws. A significant change in operation of jaws brought about by a modification of gill covers will necessitate compensatory changes in the breathing mechanism.



Left, scanning electron microscope photographs: *Top to bottom:* lower jaw teeth of *Haplochromis intermedius.* The outer row of teeth have two cusps, while those of the two inner rows have one or three cusps. These pointed teeth are well adapted for handling insect larvae; lower jaw teeth of *Corematodus shiranus,* which are well adapted for scraping scales off other fish; throat jaw teeth of *Haplochromis placodon,* which are well adapted for crushing the shells of snails.





Above, top to bottom: diagram of one way of jaw opening in a cichlid fish. The indicated muscle lifts the first gill cover bone, which in turn pulls the second and third gill cover bones. By means of a ligament, the third gill cover bone pulls down the lower jaw, and the mouth opens; X-ray photograph by William M. Winn, University of Illinois, of a live fish with electrodes implanted in the various muscles.

The "why" of the structures

An understanding of how various structures depend on each other, and how one evolutionary change is followed by many accompanying changes in other structures, has revealed the relative ease with which some major changes in breathing and jaw operation can occur.

Why are the cichlids so successful? Cichlids have been "preadapted" for exceptionally diverse feeding habits because of their unusually modified set of jaws in the throat which enable the various species to specialize in preparation and swallowing of an enormous variety of special foods. By further specializations involving varying growth rates of certain bones and modification of the shape and number of teeth, cichlids have been able to exploit virtually all available food resources in the lake. It is known that differences in relative bone growth are governed by small hereditary differences. Therefore, we may postulate that it has been relatively simple for the cichlids to evolve such specializations.

In my efforts to explain *why* the cichlids have undergone explosive evolution in the great East African lakes, I will also consider geological and environmental factors. An age of two million years for Lake Nyasa seems a reasonable estimate. The present form and level of Lake Nyasa were arrived at only after a long series of downthrusts and uplifts. During its history the lake basin has been subjected to many changes. Geological instability could have resulted in the formation of several separate small lakes, offering opportunities for colonization on a grand scale. Physical isolation would have allowed the respective inhabitants of the small lakes to develop distinct hereditary characters and to evolve various specializations enhancing the survival of the new species. Continuing instability could have reunited isolated lakes, fragmented them again, reunited them again, and each time the process of evolution progressed. The "why" of the structure is, therefore, a complex biological problem, which I hope to understand and explain in anatomical, developmental, behavioral, genetical, ecological, and geological terms.

Dr. Karel Liem is Associate Curator, Division of Vertebrate Anatomy, Field Museum.

An ecological dilemma - our national parks

albert w. forslev

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that the tract of land in the territories of Montana and Wyoming, lying near the headwaters of the Yellowstone River . . . is hereby reserved and withdrawn from settlement, occupancy, or sale under the laws of the United States and dedicated and set apart as a public park or pleasuring ground for the benefit and enjoyment . . . of the people . . .

These words, signed into law by President Ulysses S. Grant on March 1, 1872, established Yellowstone as the first national park of the United States. Forty-four years later, in 1916, the National Park Service was established to conserve scenery, natural and historic objects, and wildlife in the parks and "to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Anyone who has waited for an hour in the long lines of traffic through Great Smoky Mountains National Park or tried to find a campsite in Yellowstone may well wonder how successfully the National Park Service has lived up to the 1916 mandate. Before we draw any conclusions let us examine some facts.

Today the National Park Service has under its jurisdiction thirty-seven national parks, over seventy monuments, and numerous historical areas, seashores, lakeshores, recreation areas, and parkways. National parks are located in 23 states and the Virgin Islands. United States national parks range from 19° to 64° north latitude and from 65° to 157° west longitude. The range of climatic environments included in this area is, to say the least, extensive.

The number of visitors to the National Parks has risen from approximately 350,000 in 1916 to almost 70 million in 1971! And this does not include another 130 million persons who will visit the other areas administered by the National Park Service this year. Yosemite National Park alone has close to 3 million visitors per year. During the 92nd Congress almost three hundred bills pertaining to the National Park Service were introduced. In 1971 two new national parks were authorized—Arches National Park and Capitol Reef National Park, both in Utah. Proposals for six other national parks were introduced in 1971.

The above statistics may indicate to some that the National Park Service has undergone appropriate substantial growth since its creation in 1916. Conservationists will take issue, however, pointing out that the Park Service has not expanded anywhere near the rate it should have to accommodate the increased population and the need for preserving our wilderness areas. Only 24 new national parks have been added since 1916. When the "Mission 66" ten-year park improvement program ended in 1966, only two new national parks had been established in that ten-year period—Virgin Islands in 1956 and Canyonlands in 1964. Facilities at existing national parks were improved, however, and the number of visitors skyrocketed. Unfortunately, appropriations for the Park Service in the 1960s did not keep pace with park usage and demands. In addition, more visitors brought more problems that had to be coped with by park officials. Although the National Park Act of 1916 states that the purpose of the Park Service is to conserve the scenery and wildlife in a manner that will leave them unimpaired for the enjoyment of future generations, we may well question whether or not this is possible with 70 million visitors a year camping, hiking, and driving over these parklands.

It is appropriate, then, on this 100th anniversary of Yellowstone that we examine the success and/or failure of the National Park Service in carrying out its mandate and that we consider the path to be taken in the second century.

Yellowstone, occupying 3,472 square miles of a volcanically formed plateau in northwestern Wyoming, derives its name from the yellow color of the rhyolite rock exposed along the Grand Canyon of the Yellowstone River. Many visitors to the park, entranced by thermal features such as geysers and hot springs, are not even aware of the existence of this beautiful 1,000-foot-deep canyon with its 109-foot Upper Falls and 308-foot Lower Falls. Stories of the unbelievable marvels of this region filtered back to frontier towns during the first part of the nineteenth century. No organized expedition visited Yellowstone until 1870, when a party led by General H. D. Washburn, Surveyor-General of Montana, investigated the wonders of the Yellowstone Plateau. The following year a survey was made by pioneer geologist Frederick V. Hayden and photographer of the early west William Henry Jackson. The efforts of the members of these expeditions led to the establishment of Yellowstone as a national park within one year. Even though these men could have staked claims and exploited the area themselves, they felt very strongly that this region should be preserved for all of the people. They campaigned vigorously to have Yellowstone protected forever for the enjoyment of everyone. We should remember the example they set, for we all have benefited from it.

Yellowstone Park owes its spectacular geologic features to 65 million years of volcanic history. The plateau was formed from layer after layer of lava pouring out onto the surface, interspersed with eruptions of volcanic ash. The violent activity appears to have continued into the ice age which began around one million years ago. The thermal features seen at Yellowstone are a result of underground water coming into contact with the still-hot volcanic rocks below the surface. Some of these features are fumaroles, geysers, hot springs, and the mud pots, paint pots, and mud volcanoes which result from the drying up of hot springs. Other geologic attractions at Yellowstone are canyons, waterfalls, obsidian (volcanic glass) cliffs, petrified trees, and glacial features. Associated with the geyser basins are deposits of geyserite or siliceous sinter, a variety of opaline silica, formed by the action of algae. As many as 250 species of algae occur in the hot springs and geysers of Yellowstone, producing a variety of colors in the water and mineral deposits. Of special note also are the travertine (calcite) deposits at Mammoth Hot Springs near the north entrance of the park.

Although most often it is the geologic features that motivate an area being declared a national park, the wildlife and plants within the park are oftentimes of more interest to the visitor and more susceptible to the effects of man's visit. Of course hunting of animals is forbidden in the national parks, as is collecting of plants, rocks, or any other natural object. For some reason fishing is not generally prohibited. Perhaps the Park Service does not consider fish to be animals. The sport and domestic fishing that is allowed within the boundaries of Virgin Islands National Park may be having an effect on the composition and density of the reef fish community.

At times the Park Service is forced to exercise "direct control" over wildlife. This occurred in Yellowstone Park in 1961 and 1962, when park rangers were ordered to

destroy more than 4,000 elk. According to the Park Service this was done because the elk herd had increased in size to the point where there was not enough food for all of the wildlife in the park. It is called "direct control" also every time a bear is destroyed because it is too dangerous to park visitors. Since 1968 over 75 bears have been destroyed in Yellowstone. Of these, 33 were grizzlies and the rest black bears.

This brings us to an interesting result of the establishment of the national park system. Before many areas such as Yellowstone were classified as national parks, a binary ecological system existed: a balance between the wildlife and its natural surroundings. After the park was established a ternary system developed: wildlife—natural surroundings—and man. National parks, as we have noted, are established "to conserve . . . the wildlife therein and to provide for the enjoyment of the same in such a manner as will leave them unimpaired for the enjoyment of future generations." The Park Service is faced with a dilemma—how can both be done? Are these two mandates incompatible? Yellowstone expects 2,361,000 visitors this year, most of them within a two-month period. In July and August 50,000 to 60,000 persons a day will enter the park. There are inside the park between 2,500 and 3,000 campsites, plus hotel and motel facilities to accommodate over two thousand more. Is it conserving the scenery to build tramlines, highways, campsites, and hotels to accommodate the visitors who wish to enjoy it? Is it conserving the wildlife to destroy the natural predator-prey relationship because the predators may injure a person who is there to enjoy the wildlife? These questions pose great problems for park administrators.

The effect of man on the ecological balance in a park environment can be resolved into two components. One is the effect of the visitor, the other is the effect of park management. What are some of the visitor effects? A large number of people in a park area means the introduction of human food. Because the animals are fed directly by humans, and because the animals eventually rely on garbage, their natural habits and behavior are changed drastically. A program has been carried out in Yellowstone since 1969 to close all garbage dumps inside the park and remove aggressive bears that frequent campsites. Bears are usually removed by transporting them to other areas of the park up to seventy miles away. Glenn F. Cole, research biologist at Yellowstone, reported that grizzly bears injured from 1 to 8 persons per year during the 1960s, for an average of 3.6 injuries per year. In 1970 three injuries were reported, and in 1971 no injuries were reported. The last garbage dump in Yellowstone was closed in 1971. There are indications that a natural ranging grizzly bear population can possibly be restored in Yellowstone. Similar control methods are being carried out at Glacier National Park in Montana. There, however, the number of visitors has not reached the point where interaction between grizzlies and humans is as frequent as it was at Yellowstone. Direct control actions at Glacier from 1968 through 1971 resulted in the destruction of 5 grizzlies as compared to 33 for the same period at Yellowstone. As Clifford J. Martinka, research biologist at Glacier National Park, puts it, "a wild, free-ranging grizzly bear population offers the least opportunity for conflict with man."

Visitors have an impact not only on wildlife in national parks, they can have a substantial effect on the landscape as well. An interesting example is at Virgin Islands National Park, where three underwater nature trails were opened during the 1960s. The reef has been damaged by indiscriminate anchoring of boats, and the scuba divers may be causing changes in the reef environment by breaking fragile coral and causing unnatural shifting of bottom sand. Visitor impact is being monitored to see if these effects are significant as compared to natural changes such as occur during storms.

Mesa Verde National Park in Colorado offers another example of visitor impact. In 1966 up to 500 people per hour were touring the cliff dwellings. Damage was becoming increasingly evident and, as a result, in 1967 tours were limited to 150 persons per hour.

Other visitor-introduced problems include the theft of artifacts, crime, fires, automobiles, water and waste treatment, drugs and drinking, and a myriad of other problems. At Petrified Forest National Park in 1967 over 360 people were caught removing over 2,000 pounds of petrified wood from the park. In just six years the number of arrests for major crimes (homicide, rape, robbery, etc.) in the national parks rose more than 400%, from 90 in 1964 to 374 in 1970. Narcotics arrests among young visitors and student employees at the parks have increased

substantially. Motorcycle gangs, in California particularly, have become a major nuisance to park visitors. How has the Park Service met these problems? Admirably, perhaps, when you consider that at Yellowstone alone the number of permanent park employees has been reduced from 135 in 1961 to only 100 in 1971 because of budgetary restrictions. The park employees must handle more visitors, more crowds, and more crime every year.

Let us now look at some other problems—namely, those that arise from man trying to manage and protect the natural environment. We have already called attention to the fact that the predator-prey relationship has been disturbed as a direct result of visitor impact. There are indirect results too of a wilderness area being taken over and managed by the Park Service with the intention to preserve and protect the area for future generations.

Often the natural area is subjected to more protection than had occurred in the past, thereby upsetting the natural ecological

balance that existed previously. An example would be the matter of striking out forest fires. When an area is declared a national park and rangers begin patrolling it, the number of forest fires is suddenly reduced. A fire that previously would have been allowed to burn is put out. This is what happened, for example, at Sequoia National Park. Sequoia was established in 1890, making it the second oldest national park. There are only two species of sequoias in North America, the giant sequoia (*Sequoia gigantea*) and the redwood (*Sequoia sempervirens*). The tallest sequoia in the park is the General Sherman Tree, 272 feet tall, with an average diameter at its base of 30.7 feet. The tree is estimated to be almost 3,800 years old. The bark near the base of a sequoia is thick, sometimes as much as two feet thick, making the tree fire resistant. Naturally occurring brush fires that swept through the region for thousands of years had little effect on these giant trees.

However, when man came into the picture he put out fires when they occurred, as might be expected. As a result, dense underbrush accumulated, and when fires did occur, the underbrush made them so intense that the sequoias began to be damaged. Also, sequoia seedlings were not able to survive as well in the heavy underbrush. Thus the future of the sequoias has been endangered by man's unnatural protection. The Park Service now allows controlled burning in a number of national parks besides Sequoia. Small fires are permitted to burn as they did in the past.

Other effects of unnatural protection by man will undoubtedly appear as we learn more about ecology and the intricate natural balance among plants, animals, soils, and other elements of the environment. The important thing is that we learn about these before irreparable harm occurs. It appears that such harm may have happened already in Everglades National Park. The Army Corps of Engineers constructed flood gates, canals, and other structures in the vicinity of the Everglades which diverted the water that once used to go to the Glades. As a result the Everglades are dying. The alligator population as well as the bird population has declined to the point where there is a danger that many species will become extinct. The droughts have become more severe, and there is barely enough water to fill the small waterholes which the alligators and birds depend on in the dry season. At the same time, poaching has become so prevalent that the future of alligators is precarious. We should remember this the next time we are tempted to purchase alligator bags, shoes, wallets, and the like.

I mentioned previously that park rangers shot 4,000 elk in Yellowstone during the winter of 1961-62 because of a shortage of browse. Wildlife management, one of the functions of the park service, represents another effect of man's intrusion into the natural ecological balance. When to exercise direct control and when not to leads to another dilemma. The amount of browse available, number of predators, disease, fire, and weather are the natural controls of wildlife populations. When man enters the scene, either as a visitor to the parks or as a manager of the parks, disrupting these natural controls, the Park Service must, in most cases, take over the function of wildlife control. In 1961, the elk herd had grown to 10,000 and the amount of browse available could sustain only 6,000, so direct control was put into effect.

There are few national parks where man has not significantly affected the ecological balance between predator and prey. One of the few is Isle Royale National Park, an island in Lake Superior. The water barrier has kept Isle Royale relatively, but not entirely, undisturbed by man. No automobiles are allowed on the island, and visitors must take a ferry to reach it. Thus natural fluctuations in an animal population can be observed somewhat better here than many places, even though few mammals inhabit the island because of its isolated location. Studies made since the turn of the century have shown some species of mammals to have declined or disappeared and others to have been introduced or increased over the years. For example, the moose population on the island before 1920 was around 200 to 300. By 1930 it had grown to 3,000. Naturalists examining the island in 1930 found it had been overbrowsed and they predicted a die-off from malnutrition. This indeed happened between 1933 and 1936, climaxed by a fire which burned off the browse on over a

Photos courtesy of National Park Service, U.S Department of the Interior.

quarter of the island. By 1936 the moose population had dropped to about 500. The numbers increased to about 800 by 1948, when wolves joined the fauna of the island, probably by migrating over winter ice from Canada. Then man decided to help things along and introduced four zoo-bred wolves in 1952. These soon had to be shot or returned to the mainland because they were dependent on humans for food and they harassed people on the island. Meanwhile, the timber wolf population increased naturally through more migration from Canada and births on the island, and in 1956 there were 14 wolves known to be on the island. Since then the number of wolves has risen to as many as 28. The wolves' main source of food is the moose herd, and it is believed that at present a stable moose population of around 1,000 coexists with a wolf population of about 22. The wolves kill the older, weaker moose or the weaker of twin calves for food. As a result, the moose population remains healthy because only the strong survive. This type of wildlife control is certainly preferable to the indiscriminate shooting of animals by man.

What then, do we do now, in this second century of our domain over parkland? Do we ban visitors from the parks entirely? Do we just eliminate automobiles? Or do we build more roadways, tramlines, and campgrounds because "parks are for people"? If so, how do we preserve the environment "for the enjoyment of future generations"? These are some of the questions facing the National Park Service on the 100th anniversary of Yellowstone. One thing we must not do is confuse "enjoyment" with "recreation" or "entertainment." This distinction perhaps has not been understood in the past by both the Park Service and the visiting public. The recent establishment of a skiing school in Yosemite; the famous, but now stopped, nightly "firefall" in Yosemite where burning embers were pushed over a waterfall; the commercialization of national parks as at Hot Springs, Arkansas and numerous other places; motorboating; and a variety of other entertainment and recreational activities—all seem to be out of character with the original purposes for which parks were created.

Would it be better perhaps to not refer to national parks as "parks"? I would venture to guess that attendance would drop off rapidly at Mesa Verde National Park if it were called Mesa Verde National Archeological Site. The National Park Service has taken a step in this direction with the establishment of national wilderness areas, seashores, lakeshores, and rivers.

Although the Park Service feels it must serve all the people it possibly can, it has now found it necessary, in some parks, to establish a reservation system for campgrounds and other controls on visitors. Thought is being given to keeping automobiles out of such crowded parks as Yellowstone and in their place run tours on electric buses. Many officials hope to exclude all such services as hotels and gas stations from the park area proper. Some park administrators encourage more backpacking into the wild areas of a park now visited by very few people. North Cascades National Park in Washington, one of our newest (1968), may set such a direction for the future. There are no roads and all motor vehicles are prohibited. There are, however, over 300 miles of trails winding through the rugged peaks, mountain lakes, and glaciated valleys.

Establishing more national parks near urban areas is something also being considered. Except on the west coast, there are no national parks near major urban centers—none near New York City, Chicago, Detroit, and Cleveland, for example. The Indiana Dunes National Lakeshore, to be funded in the 1973 fiscal budget, will be the first federally protected "urban" park area in the midwest. However, some conservationists feel that the pressure on the Park Service to develop more urban parks may be political expediency which will delay acquisition of more wilderness areas. Both needs should be given serious consideration.

Having personally enjoyed the grandeurs of Alaska, I sincerely hope that our state and federal governments will soon take action to preserve our last frontier by establishing more parks and monuments in the northwest wilderness soon to be bisected by a pipeline.

So, birthday congratulations to Yellowstone! May you live at least another hundred years. And may we all have the generosity and foresight that the people of the Washburn and Hayden expeditions had. If we do, a hundred years from now our descendants may bless us, not curse us.

Dr. Albert W. Forslev is Professor and Chairman of the Department of Earth Science at Northeastern Illinois University; he was formerly Associate Curator of Mineralogy at Field Museum.

The World is Our Study

Alan Solem

Behind the scenes of Field Museum, in a section of the ground floor and on parts of the third and fourth floors, sitting in countless bottles of alcohol or lying in tier after tier of wooden trays in grey or green steel cases, are the more than 7,500,000 specimens of animals that form the seven major Zoology collections—Birds, Mammals, Reptiles and Amphibians, Fishes, Anatomy, Insects, and Invertebrates. Gathered together since 1893 by means of purchases, donations, expeditions, and exchanges, specimens originating from every continent, every ocean, and most islands of the world form one of the great international resources in natural history. They are consulted by students and scientists of many nations. They form one of the major responsibilities for the 12 scientists and 13 assistants of our present Department of Zoology staff.

Used in systematic research, to provide service identifications, for comparative studies, and to derive theories concerning evolution, these collections are a biological "Bureau of Standards" of the animal world. They are filed away in a system that continually changes as the progress of systematic research alters ideas of animal classification and phylogeny. With the collections accumulated to date, it is possible to study animals from most parts of the world and to focus research on problems at a high level of sophistication. Not only can we study material now available, but we have sufficient background material to make new field work in any area of the world effective and productive. We not only "study" animals of the world in our offices, but for each collection we view the entire world as potentially our field of "study." Less than a dozen museums in the world attempt to maintain such a "world view" of zoology, and none of these is as young as Field Museum.

In the beginning, back in 1894, Field Columbian Museum had Departments of Anthropology, Botany, Geology, Zoology (except Ornithology), Ornithology, and Industrial Arts. The Industrial Arts section disappeared quite early, but it was not until 1906 that Ornithology was reunited with Zoology and the scientific departments of Field Museum of Natural History assumed the shape that persists today—Departments of Anthropology, Botany, Geology, and Zoology. The biological collections consisted of materials displayed at the Columbian Exposition of 1893, most of which had been assembled by Ward's Natural Science Establishment of Rochester, New York. At first there were two scientists in Zoology and two in Ornithology. Over the years, in a series of expansionary bursts, staff, library, and collections grew to the size of today. Involved at every stage of growth were scientists, wealthy patrons, amateur students, and volunteers. Often the same individual might be patron, volunteer, and scientist, while more than one amateur has, in time, become a world authority on a particular group.

Because it began separately, the collection of Birds is perhaps easiest to trace through the years. It also illustrates quite well the interactions between people in the community and on the Museum staff that result in progress and growth. Perhaps the initial separation of Birds as a Department of Ornithology resulted because the President of Field Columbian Museum, Edward E. Ayer, donated a magnificent library on ornithology, and this combined with the possibility of hiring a well known ornithologist, C. B. Cory, who would bring a large collection of bird skins with him. Early years were spent in building the collections and gathering data for Cory's major publications on, first, the birds (1909) and then the mammals (1912) of Illinois and Wisconsin. There have been subsequent publications on the mammals of Illinois, but the bird study remains as a standard reference. At the same time, Cory was starting work on birds of the Americas with a series of notes on new species and races from South America. Cory became Curator of Zoology in 1906. In 1909 a young scientist, W. H. Osgood, was hired as Assistant Curator of Mammalogy and Ornithology. Osgood's research interests were in mammals, but in 1920 he met a wealthy and enthusiastic bird hunter named Boardman Conover. A trip to Venezuela together that resulted in a short paper published by Field Museum in 1922 on game birds from northwestern Venezuela also launched Conover into a lifetime study of game birds. Infrequent visits to the Museum soon turned into five-days-a-week study. In time Conover became the world authority on game birds. He was a longtime Trustee of Field Museum and generous donor, and the Conover Fund for specimen acquisition stands as a continuing monument to his interest in Field Museum. Through his labors the last four of the fifteen-volume *Catalogue of Birds of the Americas* started by Cory before World War I were completed in 1949. This gifted amateur Conover carried the work to final completion, but it was the professional scientists Cory and, above all, Charles Hellmayr who initiated, organized, and did most of the work on this project.

The interest in the American bird fauna continues with the studies of Emmet R. Blake, Curator of Birds, and a major Bolivian project just initiated by Melvin Traylor, Associate Curator of Birds. The Old World was far from neglected, with publications on birds from New Guinea, Nepal, Gabon, Tristan da Cunha, and the Philippines by Austin L. Rand and several studies on Chinese and African birds by Melvin A. Traylor in recent years. In the years following World War II, under the curatorship of Rand (later Chief Curator of Zoology) the growth of the Old World collections received their greatest impetus; the 15,000-specimen van Someren collection from East Africa, the 21,000-specimen Koelz collection from India and Iran, and a complete set of New Guinea birds by exchange from the American Museum were all arranged through his initiative. The Ayer library on birds is one of the finest in the country and was described by J. T. Zimmer in a two-volume catalog issued in 1926. The

collection of 325,000 bird skins is perhaps third largest in the United States.

Besides Boardman Conover, other volunteers have made and continue to make great contributions to Field Museum. During the mid-1930s Eilen Thorne Smith offered to help with cataloging, card filing, and other routine chores. As she phrases it, "If I'd known that during World War II I'd be keeping the whole Division of Birds operating while the scientists were in the services, I might have hesitated to start!" For many years she has served the Museum in a variety of ways, most recently as founding President of the Women's Board. Currently another volunteer, Blair Winter, spends 3½ to 4 days a week checking and compiling data for a projected gazetteer of collecting localities in South America. So many scientists and professional collectors have sent bird and mammal specimens to museums that literally thousands of localities are mentioned on specimen labels. Each year scientists independently must spend hundreds of hours checking out the same references. A published gazetteer of such localities will provide a working tool of incalculable value to generations of scientists. With the direction of mammalogist Hershkovitz and ornithologist Traylor, Blair Winter's work will aid thousands of scientists in years to come.

Since its inception, Birds has had two scientists and one or more assistants. It is a museum in a microcosm and illustrates the pattern for Zoology: a mixture of people, library, and collections combining to advance and preserve the fund of man's knowledge concerning the world around him. Financial and time support by individuals from the community; the labors of individual scientists; the accumulation, care, and use of the working tools (library books and specimens)—all these interact complexly over the decades to result in the research, exhibits, and knowledge that the specimens in our storage cases document.

But Birds is only one facet of Zoology. In 1894 the scientific staff of Zoology consisted of the Curator, D. G. Elliot, who was a mammalogist, and an Assistant Curator, O. P. Hay, interested in fishes. Despite their interests, all animals except birds were their responsibility. Hay did not remain long, and was followed in 1896 by S. E. Meek, whose studies on the fishes of Mexico and Panama, published by Field Museum, remain landmarks in ichthyological research. Elliot was a compiler and collector, highly productive in descriptive and cataloging work. Some 3,350 pages of technical reports published by Field Museum issued from his pen. Under his leadership the Department of Zoology took its first tentative expansion steps.

The hiring of E. N. Gueret as osteologist in 1899 and William J. Gerhard as entomologist in 1900 initiated the trend of dividing responsibility and increasing the staff to meet the demands of growing collections and research potential. Gueret's primary concern was in preparing skeletons for exhibition and study, and he was active until his death in 1940. Our exhibits of skeletons and anatomy collections are lasting monuments to his skill. In 1929 a young assistant, Dwight D. Davis, was added to the then "Vertebrate Skeletons" section of Zoology. Promoted to Curator of Anatomy and Osteology in 1940, Davis became probably the premier comparative anatomist of the United States. His monograph on the functional anatomy and relationships of the Giant Panda, published just before his death in 1965, has been cited as making the Giant Panda one of the three or four best known animals in terms of anatomy. Previously it was totally unknown. Since 1965 the tradition of fine anatomical research has been carried on by Karel Liem, a specialist in fish morphology who has recently returned from a Guggenheim Fellowship in Europe.

William Gerhard was not a publishing scientist. His contribution lay in starting a functional collection of insects and for the incredible variety of tasks that he performed in aid of his colleagues and the Museum. Most of the current exhibits of invertebrates were his creation, many major publications of other zoologists were edited and checked by Gerhard, and generations of Chief Curators relied upon his record-keeping and chore-tending. A quiet and modest man who retired in 1951 after more than a half-century of service, he continued working essentially every day until his death in 1958.

Until 1930 Gerhard was alone in Insects, but with the addition of Emil Liljeblad, first as Assistant, then as Assistant Curator,

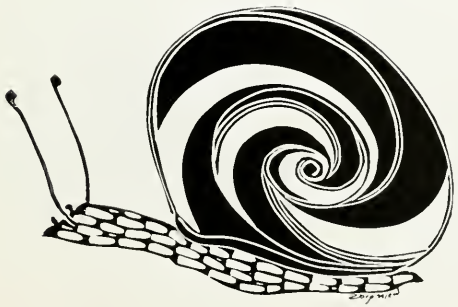
growth of the Division of Insects began in earnest. After Liljeblad retired in 1940, Rupert L. Wenzel was hired as Assistant Curator and, in 1942, Henry S. Dybas as Assistant. They are now, respectively, Chairman of the Department of Zoology and Curator of Insects. It was through their collecting and curatorial efforts that the Insect collection and library rose to their present position of eminence. For some groups of insects, Field Museum has the finest collections in the world. Few major monographs of beetles, water mites, or ectoparasites are published anywhere today without mention of Field Museum material. Most recently John Kethley, a young specialist on mites, has joined the staff and is working on varied aspects of mite systematics, evolution, and ecology. Over the years a number of distinguished Research Associates, collaborators, and volunteers have greatly aided the Division. Research Associates included Alfred E. Emerson, a termite specialist; the late Charles H. Seevers and David Kistner, world authorities on termitophilous and myrmecophilous staphylinid beetles; Harry Hoogstraal, a famous and productive student of ticks and tick-borne diseases; the late Alex Wyatt, a knowledgeable amateur authority on moths; Robert Traub, a specialist on fleas and medical entomology; Arthur Allyn and Lee Miller, founder and Curator, respectively, of the Allyn Museum of Entomology; and many others. All have contributed time, specimens, and knowledge.

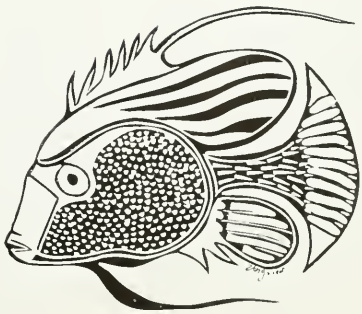
Size of larger zoology collections

Group	*1921*	*1946*	*1971*
Birds	51,160	177,121	325,000
Mammals	21,857	55,739	108,000
Amphibians & Reptiles	3,000	46,000	197,000
Fishes	97,520	427,940	800,000
Mollusks	30,000	267,000	1,940,000
Insects	137,352	462,717	ca. 4,000,000
Totals	340,889	1,436,517	7,370,000

Since the pre-1900 reign of D. G. Elliot the track of both mammalogical and ichthyological interests has continued unbroken. After Elliot's retirement in 1909, Wilfred H. Osgood began his long association with Field Museum. He was the equal of Elliot in terms of research productivity, and his studies on the deer mice of North America charted the way for hundreds of studies on this highly variable group. By any standards, it is a landmark in mammalogy. Equally well known are his study on the *Mammals of Chile* and a classic review of the primitive South American marsupial *Caenolestes*. Osgood became head of Zoology in 1921 and was succeeded as mammalogist by Colin Sanborn. An excellent field collector and student of bats, Sanborn added much material to the collections and was responsible for encouraging several people to become biologists. Today Philip Hershkovitz, world authority on South American mammals and primates, plus Luis de la Torre, a specialist on bats, continue to build upon the research foundation laid by Elliot, Osgood, and Sanborn.

For most of Zoology's history, Reptiles, Amphibians, and Fishes have been intermingled for study, if not for care. S. E. Meek published widely on all groups, although his fame depends on his fish studies. Starting in 1921, responsibility for the fish collection was separate, with first A. C. Weed and then Loren Woods amassing almost a million specimens and bringing superb order to important but chaotically organized collections. Amphibians and Reptiles were entrusted in 1921 to Karl P. Schmidt. An eminent herpetologist and ecologist, the only Museum staff member to be elected to the National Academy of Science, and a great man in every sense of the word, Karl Schmidt perhaps had more influence on young biologists than any man in the museum world. First in Amphibians and Reptiles, then as Chief Curator of Zoology from 1940 to 1955, Karl Schmidt met, enthused, and helped literally hundreds of young scientists. He transmitted a spirit, a joy of study, to his colleagues that set the tone for perhaps the most productive years of Field Museum in terms of research up to that time. Following him were Clifford Pope, a specialist on the ecology of salamanders, an excellent curator, and author of many popular books; then R. F. Inger, an ecologist and frog systematist interested in





tropical ecology, who also worked on fishes for Field Museum, and now is Assistant Director for Science and Education. Currently Hymen Marx, a student of snake phylogeny and specialist on vipers, is charting new approaches to the study of snake evolution.

The last collection to be separated was that now housed in the Division of Invertebrates. As Elliot in 1894 had "all animals except birds," so Invertebrates has "all animals that aren't studied elsewhere." Established in 1938 with the hiring of Fritz Haas, the world authority on freshwater clams, the then Division of Lower Invertebrates has specialized on mollusks, rapidly building up to its current almost 2,000,000 specimens. Fritz Haas was one of the most prolific scientists ever to work for Field Museum, publishing 89 papers totaling 2,454 printed pages during his career in Chicago from 1938 through 1967. Prior to this time he had written 230 papers while a curator in Germany. Since 1959 Invertebrates has been the responsibility of Alan Solem, a specialist in the evolution, morphology, and systematics of land snails.

This traces the expansion and development of separate Zoology collections but obscures the overall pattern of expansion in bursts. From 1894 until 1920 the professional staff fluctuated between 4 and 5 in number. During the 1920s and 1930s, under the leadership of W. H. Osgood, the staff expanded to 10 people. Immediately following World War II, in 1946, the curatorial staff reached a high of 13 people, only to drop back to 10 in 1956 and fluctuate between 11 and 12 people since then.

Just as the expansion in numbers of professional staff grew in bursts, so the pattern of staff activities has changed over the years. The initial emphasis was on faunistic research which surveyed and classified the animal life of a region, utilizing the relatively small collections. Expeditions to gather display and research materials were the aim until after World War I. With the move to the present building completed, the entire Museum was faced with a monumental exhibition program. Vast halls awaited creative efforts, and during the 1920s and 1930s almost every Division of the Zoology Department had its own model maker or crew of taxidermists. For example, the then Curator of Birds, Rudyerd Boulton, from 1931 to 1942 devoted most of his time

Illustrations from original linoleum cuts by Zbigniew T. Jastrzebski.

to developing the bird habitat groups and systematic series now on display. The habitat groups of birds and mammals; the exquisite models of reptiles, fishes, and amphibians; the skeletons and anatomical models at Field Museum—all attest to the unique skills of craftsmen in Zoology working under the guidance of the curatorial staff.

By the early 1940s most of the major exhibition work had been accomplished. Following World War II came the period of greatest collection and library growth. The accompanying table shows the size of big collections in 1921, 1946, and 1971. In our second quarter-century there was an average 421% growth. In the third, starting from a much larger base, a 513% increase, with both mollusks and insects growing more than 700% in collection size.

Today the collections of Zoology are major in size and still growing, but the professional staff is the same size as in 1946, although with vastly increased collection resources and responsibilities. We view the animals of the world, and we consider that "The World Is Our Study."

We can review the past, and adequately state the present, but predicting the future is more difficult. What will the next quarter-century bring? Certain aspects are clear. There will be much greater use of modern technology. Computer studies by Marx and Inger, scanning electron microscope analysis by Solem and Wenzel, studies of muscle function by Liem, chromosome and DNA reports from de la Torre, and serological studies by students portend the future. There will be greater involvement of staff in graduate education and considerable growth in cooperative research involving scientists from several disciplines. Anatomical projects by an ichthyologist and a herpetologist and initiation of a project on cat developmental genetics by an acarologist and a mammalogist continue the trend started by work on mammalian parasites by mammalogists and entomologists as well as a situation where a vertebrate anatomist (Davis) and an entomologist (Dybas) studied populations of the periodical cicada in 1956.

Field Museum also stands on a threshold of launching complete revision of existing exhibits, which will require expert knowledge and consultation in planning by the scientists. Problems in ecology, conservation, and management of natural areas will require increasing amounts of time. Yet the basic demands of collections and research remain. Despite the size of our collections and those in other museums, collections today are still inadequate to study geographic variation in even common species. Few collections contain more than 40% of the species known in a particular group. Our collections must continue their growth to maintain excellence. To meet these plus the new demands will require another burst of staff expansion.

This then is a brief review of Zoology: of its collection and staff growth, of its areas of interest, and a small sampling of its accomplishments in research. How small a sampling may be judged by the omission of much research and virtually all research associates and volunteers except a few in Birds and Insects. Each Division has a story equivalent to that related concerning Birds, but space and time have dictated the brief introduction presented here.

Dr. Alan Solem is Curator, Division of Invertebrates, Field Museum.

Twelve men to learning much inclined

elizabeth munger

Zoology is Field Museum's largest scientific department because the numbers of species of the animal world and size of the collections are so enormous, and differences are often so sharply defined, that many different kinds of special knowledge are necessary to curate and study them. Zoology's scientists are all different from one another too. Perhaps the one common element is that they all have published widely in their respective special fields, including popular as well as technical books and articles. Their names, widely recognized and respected in the scientific world, are therefore also often familiar to general readers.

Rupert L. Wenzel, Chairman of the Department of Zoology, was first fascinated by insects as a high school student. Then as a student volunteer worker at Field Museum, he and equally young Henry Dybas often collected together along the beach at the Indiana Dunes. One thing led to another, and led Wenzel to choose zoology as his major, studying under the late Charles Seevers at the old Central YMCA College; to become a research assistant to zoology professor Alfred E. Emerson and begin graduate study under him at the University of Chicago; and then at the age of 25 to become Assistant Curator of Insects at Field Museum. Much of his research work has involved unraveling the mysteries of the classification, evolution, and biogeography of the histerid beetles and of external parasites of mammals, especially the batflies. "Service" may be the one best word to describe the other aspects of Dr. Wenzel's career—service to the scientific community at large; to many learned and professional societies; to educational, cultural, and humanitarian groups; and to his home community Oak Park—in many capacities over the years.

As a boy, Luis de la Torre, who will formally assume his duties as Curator and head of the Division of Mammals later this year, often accompanied his parents on Sundays to the country club on the outskirts of Madrid where his national champion father was the golf professional. In the nearby fields and forests he would observe everything that was alive. When the family came to this country during the Spanish Civil War and settled in Highland Park, Illinois, young Luis became acquainted with Field Museum mammalogist Colin Sanborn, who encouraged him to train for a career in zoology. The Museum's Thomas J. Dee Fellowship, awarded to him in 1955, helped out during graduate school, as did his own skill at golf. Now Dr. de la Torre's main specialization is the classification, biology, evolution, and distribution of the largest single group of mammals in the New World tropics—bats. Besides designing optical and electronic instrumentation for DNA microspectrophotometric studies, this versatile man has also had many photos and photomicrographs published in textbooks and elsewhere and has produced motion pictures that have been used for students and popular science programs on network TV.

A list of the professional publications of Philip Hershkovitz, Research Curator, Division of Mammals, now numbers over 100, and that is only the scientific monographs and papers, not counting popular articles plus the well over 100 entries and articles he has written for six different encyclopedias. Just one of the major projects he is presently working on is a monumental study of New World monkeys, to be published in three volumes by the University of Chicago Press. (Volume 1 is 1,500 manuscript pages with 500 illustrations.) Hershkovitz has described himself as choosing to work on a series of small, bite-sized pieces; others describe him as one of the world's leading authorities on the classification, origins, evolution, and dispersal of mammals of the American tropics. His early interest in natural history can be partly credited to the elementary school visiting program to the Carnegie Museum in his native Pittsburgh. But it wasn't until he took his first course in zoology at the University of Pittsburgh that he learned he was most interested in vertebrates, and in whole animals and whole animal systems. He has used this holistic approach on his several collecting expeditions to South America. More often than not they have been of several years' duration so that he could observe and collect a great number and variety of animals with the changing seasons.

Karel F. Liem, Associate Curator and head of the Division of Anatomy, decided that the U.S.A. was where he felt most at home after he came from Indonesia on a U.S. government fellowship to do his Ph.D. work at the University of Illinois. His first language is Dutch, but he is equally fluent in German, French, Indonesian, and especially English, as his article elsewhere in this issue of the *Bulletin* demonstrates. (And his high school English teacher in Bandung flunked him!) That article describes some of his most recent research work, on the functional significance of anatomical differences. Dr. Liem has always combined research with teaching courses in human anatomy. Awards three times from his students have shown how much they appreciate what an inspiring teacher he is. But Dr. Liem is an abysmal failure at swimming. He is now enrolled in a YMCA beginners' class—for the second time. His intensive work on the anatomy of fishes has convinced him that swimming is impossible for people because the human anatomy is just not designed for it. Unfortunately, Dr. Liem will soon be leaving his joint appointment at the Museum and the University of Illinois Medical School to assume the Bigelow Professorship at Harvard University's Museum of Comparative Zoology.

To find Alan Solem, Curator and head of the Division of Invertebrates, one must ascend to as close to a tower as we can come at Field Museum, which is the fourth floor level where a light well used to be. There in well equipped bright new labs, library, and offices, Solem and his staff work with the collections and do sophisticated research on mollusks especially. For much of his current research Dr. Solem must use a scanning electron microscope, a recently perfected instrument that enormously extends man's vision into the microworld. He has pioneered in use of this instrument to study the teeth and feeding mechanics of both plant- and animal-eating snails. Among other things, Dr. Solem, a world authority on the anatomy, classification, and evolution of terrestrial and fresh water snails and slugs, is trying to discover why the distribution patterns of non-marine mollusks are so very different from those of the vertebrates. Though his research interests are esoteric, Dr. Solem has a talent for generalizing scientific principles and theories to students; and also a talent for presenting delightful sidelights on the world of shelled creatures through the many popular articles he has published in this magazine and elsewhere.

"Hy" Marx, Associate Curator and head of the Division of Amphibians and Reptiles, always has a friendly word to offer or sympathetic and wise counsel or opinion if requested. He once got a request to "Please send me information on snakes, especially Boa-Constrictors. I have a six-foot one and I use him in an act here in Dallas. I'd like

Photo by George D. Olson

It was six men of Indostan/To learning much inclined./Who went to see the Elephant/(Though all of them were blind),/That each by observation/Might satisfy his mind.—from a Hindu fable as told by John Godfrey Saxe, 1854. *Department of Zoology staff members, top row:* Barbara Brown, volunteer, Mammals; Valerie Canty, technical assistant, Mammals; René Laubach, curatorial assistant, Mammals; *second row:* Blair Winter, volunteer, Birds; Dennis Derda, assistant, Reptiles; Marilyn Belka, secretary, Reptiles; Carolyn Evers, departmental secretary; John Kethley, assistant curator, Insects; Hymen Marx, associate curator, Reptiles; *third row:* Philip Hershkovitz, research curator, Mammals; Karel F. Liem, associate curator and head, Anatomy; Loren Woods, curator and head, Fishes; Emmet R. Blake, curator and head, Birds; Rupert L. Wenzel, chairman of Zoology and curator, Insects; Henry Dybas, curator and head, Insects; Luis de la Torre, curator and head, Mammals; Melvin A. Traylor, associate curator, Birds; *bottom row:* Verne Reaves, technical assistant, Insects; Robert Schoknecht, assistant, Fishes; Pat Peyton, secretary, Insects; Nancy Kozlowski, secretary, Invertebrates; Michael Prokop, assistant, Insects; Helen Palmer, secretary, Mammals; Nancy Whitt, technical assistant, Insects. *Staff members not in picture:* Sophie Andris, osteologist, Anatomy; Louise Bernard, preparator, Insects; Keith Carson, tanner, Mammals; Dianne Maurer, assistant, Birds; Alan Solem, curator and head, Invertebrates; Barbara Walden, assistant, Invertebrates; J. L. Williams, assistant, Anatomy; Carole Wrigley, illustrator, Invertebrates; August Ziemer, preparator, Insects. More than forty other people work with the Department of Zoology and its collections as research associates, associates, and volunteers. Many are distinguished scientists and teachers on the faculties of various universities.

to know how to tame him and break him from biting. [signed] Melanie S., Go-Go Snake Dancer." Part of his reply reads: "If it is the species that is known as boa constrictors, then it is well for you to know that they are by nature aggressive biters. However, a reticulated python which will reach coverage size has a much milder and gentler disposition. Constant handling and body contact will keep the snakes usually in a docile condition." Hymen Marx never talks about himself, but ever since he came to Field Museum as an Assistant in 1949, directly from Roosevelt University, his scientific work has spoken for him. He has built an ever more solid reputation among his colleagues both here and elsewhere by his research on a variety of subjects, ranging from the logic and methodology of character analysis in determining evolutionary relationships for classification, based on his work on snakes, to the speed of the lizard *Basiliscus*, which runs on water.

A full true story of the career of Emmet R. Blake, Curator and head of the Division of Birds since 1955, would read so much like a boy's adventure fantasies that it might not be believed Before he officially joined the Museum staff as an Assistant in 1935, he had already been on four expeditions to Central and South America. In the classic tradition of the explorer-naturalist, Dr. Blake's field work has often penetrated into zoologically unknown areas. Under the heading "World War II," some records read: "Specialized in counter-espionage . . . 'D' day landings at Salerno, Anzio, and Southern France . . . Received Battlefield Commission Nov. 17, 1944 . . . Special assignments tracing and recovery of Gestapo and concealed gold hoards, apprehension of foreign secret agents, etc." The desk work necessary to disseminate the results of his ornithological work may seem tame by comparison, but he has accomplished a great deal of that too. His current long-term publishing project, a *Manual of Neotropical Birds*, which will be several volumes, will cover complete descriptions and information on the distributions and habitats of the 3,200 species of tropical American birds from Guatemala southward.

Melvin A. Traylor's avocation became his vocation when he was appointed Assistant Curator of Birds in 1956 (he is now Associate Curator). For many years before that he had worked informally with the Museum in several capacities. As Captain Traylor (USMC), after his World War II service in the South Pacific, he observed the 1946 atomic bomb tests at Bikini Atoll, on assignment for the government's study of effects on wildlife. The first article he wrote for this magazine reported some of his observations both before and after that milestone event. His career ever since has been dedicated to the study of bird speciation and distribution. He shares the concern of all naturalists about the diminishing variety of wild life that man and his technology seem to be causing—which is the subject of his article in this issue of the *Bulletin*. He is a leading authority on African birds; has collaborated with a U.S. Naval medical research laboratory in Cairo on studies of migratory birds and their ticks in relation to certain viral diseases; and continues work on the monumental *Peter's Checklist of the Birds of the World*.

Loren P. Woods, since 1947 Curator and head of the Division of Fishes, recently published *Fishes* as one of Follett's Beginning Science Books for very young readers. Of course he also has written reports that usually only other scientists read. In between these extremes there have been many articles for this magazine, most recently about how and why our Great Lakes are changing. Mr. Woods used to lecture to youngsters when he first came to Field Museum in 1938, for the Raymond Foundation, whose education programs have served generations of Chicago-area school children. He has built the collection of fishes to about 800,000 specimens; has become a world authority on the primitive spiny-rayed Berycoids; has participated in and reported on material from several oceanographic surveys; all of which have added enormously to our knowledge of the classification and distribution of fishes and of world fish resources and marine ecology.

"He is one of the best field entomologists and collectors in the country," says one of his colleagues about Henry Dybas, Curator and head of the Division of Insects. "He knows so much about insect ecology and the kinds of niches they can be found in, especially the cryptic, hidden, forms, that he can exploit what other people overlook." His research specialties include the classification and biology of featherwing beetles, which are among the smallest known insects and are indeed cryptic, the smallest being 1/75 inch long. What their role might be, along with other forest floor insects (and mites) in reducing organic detritus to form soil nutrients, is an especially interesting problem. Study of the population dynamics, ecology, and evolution of the 17- and 13-year periodical cicadas is another of his specialties. Their dramatic behavior when they emerge by the millions may be more obvious, but may not be more important in the ordering of the natural world. Mr. Dybas describes himself as "a product of Field Museum" because during high school days he came often for identifications of insects he had collected.

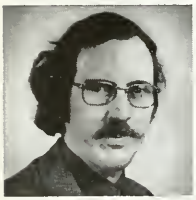
John Kethley, the youngest member of Zoology's professional staff and Assistant Curator in the Division of Insects, specializes on mites. Their important effects on public health were highlighted by World War II experience with scrub typhus, a disease transmitted by chigger mites. They are now recognized as important to study for other reasons too. Bird quills and the mites living in them represent, for instance, a relatively "simple" ecological system, and understanding such a system would help explain more complex systems. One thing Dr. Kethley has discovered is that different species of mites might live in the quills of a single species of bird and "divide the territory" by each species adapting to different kinds of quills. Mites can thus tell us something about fundamental problems of evolution and ecology—namely, how populations of related forms adapt so they can coexist and share resources in the same habitat rather than compete, to the eventual elimination of one or more.

Besides the present eleven curatorial staff members of Zoology, Dr. Robert F. Inger, formerly Curator and head of the Division of Amphibians and Reptiles and now Assistant Director for Science and Education, should be counted as a twelfth. He continues his research on the organization of animal communities, particularly of reptiles and amphibians in tropical forests and streams, and has also been deeply involved in launching The Institute of Ecology as a comprehensive independent agency to support ecological research and forecasting.

Elizabeth Munger is Associate Editor of the Field Museum Bulletin.

FIELD BRIEFS

New Education Department Chairman



Robert A. Matthai

Robert A Matthai has been named chairman of the Department of Education at Field Museum of Natural History.

Mr. Matthai comes to Field Museum from the American Museum of Natural History, New York City, where he served as assistant curator of education. Prior to that appointment he was director of the American Indian Program, and assistant director, Office of Field Activities, at the Harvard Graduate School of Education.

As a volunteer in the Peace Corps, Mr. Matthai spent two years in Ethiopia, after which he became an instructor in a Peace Corps training program.

Mr. Matthai received his bachelor's degree in history from the University of California, and his master's degree from the Harvard Graduate School of Education. He is presently completing a dissertation for his doctorate from the Harvard Graduate School of Education.

The Department of Education is responsible for an ever increasing number of activities involving the Museum and the community. In 1971 it provided 6,785 organized groups, or 346,792 individuals, from schools, universities, Scouts, Y's, senior citizen centers, 4-H, Project Head-Start, the Chicago Park District and others with special services. One of the unique courses it offered was an in-service training program for thirty teachers from Chicago public schools on how to interpret the Museum to classes.

National Council on Arts Grant

Field Museum has received a grant of $9,942 from the National Council on the Arts to survey its climate control, security, and storage needs. The award was one of several made by the Council to important museums and organizations across the nation for conservation and renovation of America's art treasures following a survey of 450 museums which found such programs to be of highest priority.

President Nixon, in a recent communication to the Council, supported the steps being taken to preserve cultural heritage: "the National Council on the Arts," he said, "has shown imaginative leadership and creative foresight in calling public attention to the critical problems confronting the priceless collections in our nation's museums. I am pleased to join with the Council in urging action by the private and public sectors to safeguard our museum collections. Only by such action can we preserve our treasures for generations to come."

Anthropology Training Program

Twenty-eight high ability high school seniors are participating in Field Museum's six-week summer course "Student Science Training Program in Anthropology." The students come from twenty-eight different high schools in three states and were chosen from more than 100 applicants on the basis of academic achievement, recommendation of teachers, and personal interviews. Supported by the National Science Foundation for the seventh consecutive year, the program is designed to provide a sound foundation in anthropology through lectures, seminars, workshops, individual projects, study of Museum specimens, and field work at a local archaeological site.

Building Improvements

The Museum has made the following improvements using funds contributed to the Capital Campaign: new Zoology and Exhibition Department facilities, a new Jade Hall, reinstallation of Malvina Hoffman sculptures around the second floor gallery, and permanent improvements to Halls 25 and 27 including new flush display walls, a new heating unit, and new electrical wiring and ventilation.

New Perspectives in Archaeology

Twelve high ability sophomores and juniors from colleges and universities in ten states are participating in a ten-week archaeological program this summer at the Museum's field station near Vernon, Arizona.

The tuition-free course entitled "New Perspectives in Archaeology" includes excavation and study of archaeological sites in the Southwest which were inhabited from approximately 1000 B.C. to 1500 A.D. The program is under the direction of Dr. Paul S. Martin, chairman emeritus of the Department of Anthropology of Field Museum, and is being supported by the National Science Foundation for the eighth consecutive year.

Museum Volunteers Honored

Seventy volunteers who contributed a total of 12,162 hours in 1971 to Field Museum were honored recently at a reception hosted by Remick McDowell, president of the Board of Trustees, and E. Leland Webber, director of the Museum.

The 1971 total represents an increase of 37% over the number of hours donated by volunteers in 1970. As the Museum's programs continue to expand, more and more qualified volunteers will be needed to perform a variety of important tasks in the Museum's Departments of Anthropology, Botany, Geology, Zoology, Education, Exhibition, and in the Library.

Corporate Division of Capital Campaign Make Plans

Section Chairmen of the Corporate Division of the Museum's Capital Campaign met recently to review areas of responsibility in the $25,000,000 fund drive. Seen here, from left to right, Gordon Bent, chairman, Finance and Investments Section; Blaine J. Yarrington, chairman, Corporate Gifts; David W. Rewick, chairman, Professional Section; and E. Leland Webber, director, Field Museum.

CALENDAR

Exhibits

Closes July 13

Soviet Union: Arts and Crafts in Ancient Times and Today, a collection of almost 2,000 objects representing the finest examples of artisanship from the country's leading museums. It is the largest show of its kind ever sent abroad by the Soviet Union, and is being shown in its entirety for the first time at Field Museum. The exhibit is part of the thirteen-year-old cultural exchange program between the U.S.S.R. and the U.S.A. Halls 18 and 19.

Continuing

Australian Aboriginal Art: Arnhem Land, a selection of nearly 400 bark paintings and wooden ceremonial sculptures. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit exploring the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through September 4. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. Continues indefinitely.

Chokwe Mask from Angola, on display in the South Lounge through September 10. One of the most beautiful of all Chokwe masks, it is called "Mwana Pwo," meaning young woman, and is worn by a male dancer at initiation and other important ceremonies.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Film and Tour Program

July

"Patterns for Survival" (A Study of Mimicry), a motion picture presentation at 2:15 p.m. Saturdays and Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into "Color in Nature," Field Museum's temporary exhibit.

"A Journey Back into Time," a motion picture presentation at 1:30 p.m. and 3:30 p.m. Saturdays and Sundays in the second floor North Meeting Room. The film is offered in conjunction with Field Museum's temporary exhibit, "A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley," and describes the excavation of a 2500 B.C. village.

August

"Chinese Jade Carving," a motion picture presentation, at 2:00 p.m. and 3:30 p.m. Saturdays and Sundays in the second floor North Meeting Room.

"Patterns of Life," a motion picture presentation, at 1:30 p.m. and 3.00 p.m. in the second floor North Meeting Room. The film provides background information on Field Museum's "Australian Aboriginal Art: Arnhem Land" exhibit.

Begins July 5

Guided Tours of Field Museum exhibit areas leave from North information booth at 2:00 p.m. Monday through Friday. "Through These Doors," a color motion picture focusing on behind-the-scenes activities at the Museum will be shown at 3:00 p.m. in the Lecture Hall. Through September 1.

Meetings

July 12: 7:30 p.m., Windy City Grotto, National Speleological Society.

August 9: 7:30 p.m., Windy City Grotto, National Speleological Society.

Children's Program

Movies at 10:00 a.m. and 1:00 p.m., James Simpson Theatre

July 6: **"African Safari"**
Animals of the Upper Nile.

July 13: **"A Boy and His Pet Elephant"**
Life in Southeast Asia.

July 20: **"Animal Adventures"**
Stories of a squirrel, weasels, and other small creatures.

July 27: **"Winter of the Witch"**
A modern fantasy.

Continuing

Summer Journey for Children, "Exploring Our National Parks," a free self-guiding tour honoring the 100th anniversary of the establishment of Yellowstone, our first national park. Youngsters have an opportunity to become acquainted with various features of our national parks and monuments by following the Journey through Museum exhibit areas. All boys and girls who can read and write may participate in the program. Journey sheets are available at Museum entrances. Through August 31.

July and August hours

9 a.m. to 6 p.m. Monday, Tuesday, and Thursday, and 9 a.m. to 9 p.m. Wednesday, Friday, Saturday, and Sunday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410

Volume 43, Number 8
September 1972

Field Museum of Natural History Bulletin

Concerning acquisition of antiquities . . .

For several years the Field Museum has been concerned about the scientific, ethical, legal, and diplomatic problems involved in acquiring new specimens. In regard to biological specimens, the Museum demonstrated this concern in 1970 when it, along with 28 other U.S. museums, issued a statement titled "Guidelines to Biological Field Studies" (*Science* 169:8, July 3, 1970). The cosigners of this statement agreed to observe certain standards in making field collections in order to insure international cooperation in research and to safeguard the existence of rare species. However, the statement was explicitly limited to biological collections. The Field Museum now wishes to establish similar standards with respect to our own acquisition of cultural collections, especially archaeological materials.

The situation in the national and international market for this material has reached a crisis point. Dangerously large quantities of primitive and ancient artifacts are now being stolen or looted, at times in a quasi-legal fashion; smuggled; and sold at high prices. If this market continues to operate at its present scale and in its present rapacious manner, it will quite soon succeed in obliterating large segments of the cultural heritage of mankind. The market for archaeological, anthropological, ethnographic, and artistic objects stands badly in need of regulation. However, the sector of this market most dangerously out of control is the traffic in archaeological objects—the so-called antiquities trade. The antiquities trade is therefore the main focus of this statement.

When the antiquities trade is illicit—when the objects being sold have been illegally excavated or illegally exported from their country of origin—the activity is entirely indefensible.

Whether illicit or not, traffic in archaeological objects is ethically dubious. Proponents of the antiquities trade often argue that some objects have such esthetic or other importance that a dealer or collector has a duty to see them removed from supposedly irresponsible hands in their country of origin and deposited safely in collections in Europe or America. This argument is invalid. Such considerations do not justify despoiling a nation of the finest monuments of its past.

In addition to legality and ethics, there is a third major consideration: the looting of archaeological sites is scientifically disastrous. The cupidity of dealers and collectors has led to such extensive destruction of many archaeological sites that no information about those sites survives or can be salvaged, except for the trivial information contained in the objects removed. The most serious recent destruction of sites has been in Middle America, Peru, the Middle East, and Southeast Asia, but important archaeological sites have also been looted and destroyed in recent years within the United States.

The museum profession is not innocent of responsibility for this situation. Although the number of ancient objects in private hands is very great, the museums of Europe and the United States have in the past played a central, critical part in the development of the antiquities trade through their willingness (a) to authenticate objects for public sale; (b) to pay, or advise potential donors to pay, extremely high prices for the objects they do acquire; and (c) to receive through gift or bequest objects of uncertain or illicit origin. In this manner museums have assumed the position of guarantors and price leaders in a market that, due to the prevalence of fraud and speculative investing, would otherwise be markedly less profitable.

The Field Museum, therefore, has adopted several policies, some of which are a codification of existing practices and some of which are new. Their intention is (1) to make certain that the Museum does not inadvertently acquire illicit antiquities; and (2) to promote the reduction and regulation of the antiquities market. [*The formal policy statement is printed on page 6.*]

Field Museum of Natural History Bulletin

Volume 43, Number 8
September 1972

Cover: massive ancient stelae are stolen from their sites by hacking them into pieces.

Concerning Acquisition of Antiquities
why a strict policy concerning cultural specimens is necessary

2 **The Campaign Against the Antiquities Trade**
Bennet Bronson
call to battle against the destruction of heritage, knowledge, and even life caused by this gray as well as black market

6 **Policy Statement of Field Museum Concerning Acquisition of Antiquities**
to make certain the Museum neither acquires illicit antiquities nor inadvertently encourages the traffic in them

7 **Men and Their Work**
Donald Collier
a brief history of the Department of Anthropology

10 **How I Risked My Life for Archaeology**
Susan Moore
a year in the life of a student at Field Museum

12 **An African Potter at Work**
Maude Wahlman
Ladi Kwali builds a traditional African waterpot at Field Museum

15 **People Who Study People**
Elizabeth Munger
who's who in the Department of Anthropology

18 **Capital Campaign**
introducing some business leaders who are helping to raise $25,000,000

19 **Field Briefs**

20 **Children's Workshops**

Calendar

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Editor Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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The campaign against the antiquities trade

Bennet Bronson

The subject of this article is the so-called "antiquities trade"—the commerce in stolen, smuggled, and sometimes even "legally acquired" archaeological objects (statues, bronzes, jewelry, and the like) which are taken from sites abroad, usually in one of the underdeveloped nations, and sold to collectors and museums in Europe and the United States. Field Museum has recently announced an important policy statement on the antiquities trade. Hence this seems a good time to explain to the Museum's Members what that statement is about and why the Museum feels it is necessary to have an antiquities trade policy.

The easiest way to introduce the subject is to begin with a personal experience, not because my own experiences are so unusual (in fact, most archaeologists have had similar experiences in the last few years), but because it may help explain this article's rather personal and nonobjective tone. I am, I admit, prejudiced. The things which the antiquities traders do are liable to arouse strong feelings.

The story starts in 1966, when I as a beginning graduate student was working on my first real excavation at the great Maya site of Tikal, located in the almost uninhabited rain forest area called El Peten in northern Guatemala. The year before, a wandering chicle-gatherer had come into camp to report the discovery of a new site with esculpturas—statues—at a place named Jimbal, about twenty miles to the north of Tikal itself. Although such reports often turn out to be false alarms, they cannot be ignored. So a staff member set out to make the long hike (there are no roads in that part of the Peten) out to the place of discovery. He came back two days later with the exciting news that this time the alarm had not been false: Jimbal was an almost perfect Late Classic Period site with several well preserved temples and two limestone stelae—large tombstone-shaped monuments—decorated with relief sculptures in an unusual late style.

Moreover, one of the stelae was not only sculptured but also dated: alongside the sculptured part of the design was a date engraved in the Maya hieroglyphic script. Such dated monuments are rare and of great importance, especially when they fall into the end of the Late Classic, just before the mysterious disappearance of Classic Maya civilization. The discovery would obviously have to be examined more closely, photographed, and a mold made.

Jimbal Stela 1, on which thieves used saws and stone chisels to try to remove the carving. Photo by Joya Hairs, Operacion Rescate, Guatemala.

This is where I became involved with the Jimbal dated stela. A mini-expedition was formed, consisting of four persons—one of our jungle-wise workmen to act as guide, two relatively experienced archaeologists, and I, who as the junior member of the team was deputized to carry the latex or liquid rubber with which the mold of the stela would be cast. So we set out, carrying food, machetes, hammocks, and latex—five heavy gallons' worth. We walked a very long distance along narrow, dripping jungle trails, got lost a few times, and at last arrived at this lovely place, a compact temple site overgrown with vines and splendid trees, laid out with typically Maya dramatic flair, untouched for twelve hundred years since the region's mysterious abandonment. In the main plaza the stela stood. We handled it gently. To have even moved it, much less to have attempted to take it away from Jimbal, would have seemed a desecration.

We managed to get a mold of it in the end, after waiting almost two days for the latex to dry in the humid forest air. Then we left, hiked back, made our report, and—after our blisters subsided—resumed our regular work. Six months later I returned from Tikal to the United States and gradually forgot about both Jimbal and its stela as I became involved with other archaeological problems in other places.

I did not think of it again until a short time ago when Dr. Donald Collier, one of my fellow curators, showed me an article in *Science* magazine by Clemency Coggins, an art historian from Harvard specializing in pre-Columbian America. She describes the enormous amount of damage being done at Mexican and Guatemalan sites by the agents of American antiquities dealers and illustrates her statements with a series of pictures of defaced monuments, some just chopped up with chain saws for easy transportation, and some, through the agents' carelessness, completely ruined.

One of the ruined ones, its top half splintered and left lying on the forest floor, was the stela at Jimbal— the same one I had carried five gallons of latex on my back twenty miles for. Turned to limestone dust because of the clumsiness of some art dealer's agent and because of the greed of his employer and that employer's respectable, greedy customers. All of them probably talking about the sacredness of art and the service they render to mankind by preserving it in their collections for posterity. And all of them probably calculating what their investment would be worth in five and ten years' time. The whole thing is outrageous. It must be stopped.

Admittedly, this is only one case—my own personal reason for being outraged. But there are a lot of cases and a lot of reasons, enough to outrage almost anyone.

Item: Archaeological art has recently been skyrocketing in value. Various causes, chiefly the publicity given by galleries and museums and the market manipulations of speculators, have pushed the price of ancient artifacts up to an absurdly high level. This has happened in spite of the facts that (*a*) a great many of the articles now on the market are fakes; that (*b*) nobody—not the art historians nor the archaeologists, and certainly not the innocent collectors—can tell good fakes from the real things; and that (c) a large majority of the articles which *are* genuine are smuggled or stolen.

Item: A number of entire ancient cultures—the ones whose artifacts fetch really high prices—are at the moment in the process of being systematically and ruthlessly obliterated. The Maya area is perhaps the most hard hit, but almost equally savage destruction is also taking place in the non-Maya parts of Mexico and Guatemala, as well as in Turkey, Iran, India, Thailand, Cambodia, Indonesia, Costa Rica, Colombia, Peru, Honduras, and—interestingly—the United States. Since some of these countries, including the United States, do not have effective laws to protect their ancient monuments, part of the destruction is entirely legal. But, whether legal or not, it is an international disgrace.

Item: The persons and institutions performing, directing, and bankrolling the antiquities trade are not obscure figures from the underworld. They are in fact quite respectable. They include a number of the most prominent art dealers in the United States and Europe, many art collectors, and some of the world's leading museums. At a rough estimate, around half of the major American museums with antiquities in their collections have in the last ten years

Naranjo Stela 30, as photographed by Teobert Maler in 1905; *left*, west side; *right*, east side. Photos courtesy of Peabody Museum, Harvard University.

acquired at least one important illicit archaeological object. Some may have been fooled and thought that these objects were legitimate. Many of the museums in question, however, have the reputation of being difficult to fool.

Item: A large percentage of the illicit trade is, in fact, carried out quite openly. Its supporters even defend it, claiming that such-and-such an object was too important and beautiful to be left in the care of the people of the country it was stolen from. To the citizens of that country, this argument may seem a little false in the mouths of people who regularly tear down their own monuments to build parking lots, but the dealers and collectors (and curators) who talk this way are apparently quite sincere. And even if they are frankly in the business to make money, there is not much reason to be secretive; prosecutions for fencing and receiving stolen antiquities are few and far between.

Just a few years ago the two most beautiful stelae from the famous Maya site of Piedras Negras turned up on the U.S. art market, having been cut up with chain saws by a group of alligator hunters working for an important American dealer. The fact that these particular stelae were well known, having been often illustrated in books and visited by tourists, seems not to have affected their salability. They soon found their way to two large East Coast institutions, which put them into temporary storage as a concession to the sensibilities of the Guatemalan government, the stelae's legal owner. No real effort was made to keep the secret, however. The news leaked out and the officials of the two institutions reportedly were surprised when the Guatemalans became upset and demanded that the stelae be returned. At last, after seven years, one of the institutions has agreed to give its stela back. But it lost nothing else. No names were ever publicly mentioned, and the possibility of prosecution was not even considered.

Item: The American public is suffering from the antiquities trade in a number of ways. Our own heritage is being destroyed by the pothunters with almost as much zeal as is the heritage of foreign countries. Given the laxity (or nonexistence) of American antiquities laws, the only check on the pothunters' activities is the comparatively low market value of most American archaeological material. The public's pocketbook suffers whenever another stolen object is bought by a collector and given, as a tax-deductible gift, to a museum. The idea of the tax-deductible gift is itself an admirable one and is usually an excellent bargain for the public. But when the objects being given are stolen and likely to be later confiscated, the public can lose heavily.

And finally, that segment of the public who collect antiquities themselves—and it is surprisingly large—is very vulnerable to fraud. The situation is ready-made for con men, who are traditionally fond of customers who like the idea of making big profits on things that are slightly illegal. Much of what is sold is stolen and, now that the legal situation is beginning to tighten up, may later be confiscated from the buyer. Also, a large part of the legally acquired portion of the average dealer's stock is fake. Some famous types of artifacts are almost all fakes, but so good that even the professionals—the art historians and the archaeologists—are often fooled, although they usually will not admit this in public. The fakes are even sold as stolen originals. For instance, right now the American market is being flooded with a group of excellent faked Cambodian statues which some dealers tell their customers confidentially were taken right from Angkor Wat by loyalist or communist soldiers. This is not to say that Cambodian sites are not being extensively looted or that some of this loot may not turn up on the U.S. market. My point is that the average collector—even the average collector without scruples and with an expert advisor—has no way of knowing. In a market as profitable and unethical as the present one he doesn't stand a chance.

Item: As Clemency Coggins reported in her *Science* article, the antiquities entrepreneurs are becoming ruthless not only with sites and monuments but with human lives. In Guatemala alone at least one government official and a number of Lacandon Indians have been murdered by these entrepreneurs' agents. Scattered reports are coming in from other places telling of the intimidation and beating of local policemen, over-diligent customs agents, and site watchmen. The stakes involved have become huge as the market price of antiquities continues to escalate. The speculators on that market can always close their eyes if their wares come into the shop slightly stained with blood.

It is things like these, then, that have convinced us that the time has come to do something about the situation. Part of what we propose to do is contained in Field Museum's policy statement. However, we feel that still more should be done. In the next year or so a number of other

Naranjo Stela 30 in 1971, west side and east side. Photos by Joya Hairs.

museums will probably issue resolutions on the antiquities trade, following the lead of the University of Pennsylvania Museum and the Harvard University Museums, which were the first to do so. The majority of these resolutions, it seems likely, will be directed specifically toward the illegal aspect of the antiquities business—now that the thieves and smugglers are starting to receive publicity, neither the honest museum officials nor the persons who have in the past knowingly bought stolen goods want to risk being criticized and perhaps prosecuted. This awakening desire to keep skirts clean is important and will hurt badly the racketeers who specialize in out-and-out lawbreaking. But it is only a first step.

The real masters of the antiquities trade, after all, have for long been accustomed to operating in a gray area, neither quite within nor entirely outside the law. Their agents do not sneak into sites with chain saws; they go in openly with bulldozers and papers signed by local officials. They do not smuggle their finds out in fishing boats; they send them, covered with customs seals and official permits, by ordinary air freight. And if it looks as though they will have trouble with American customs, they park their goods in a third country for a while until they can arrange to have documents made certifying that those particular objects have been in private collections in that third country for fifty years. Museum resolutions aimed entirely at the illicit trade will have little effect on entrepreneurs like these.

Field Museum's policy statement was designed to cover the gray-area as well as the clearly illicit trade. We will not, in the words of the statement, "acquire any archaeological or ethnographic object that cannot be shown to the satisfaction of the Museum official or committee responsible for its acquisition to have been exported legally from its country of origin," and we will not "acquire objects in any case where the responsible Museum official or committee has reasonable cause to believe that the circumstances of their recovery involved the recent unscientific or intentional destruction of sites or monuments." What this means, essentially, is that we do not want *any* archaeological or ethnographic objects found in the recent past or in the future which were acquired by looting or destruction of sites or monuments. We doubt that anything can be done about the spilt milk of the past, but we will be especially cautious about objects recovered within the last several years. Some objects looted as far back as 1960 are probably still in the pipeline or in the hands of the dealers who originally commissioned the looting, and profits from selling those objects would undoubtedly be ploughed back into further looting.

This also is still not enough, and will not be enough even if, as we hope, other museums join us in resolving against the gray-area trade. Several other things must be done. The federal and state governments must be urged to pass workable laws against the importation of illicit antiquities and against the looting of sites within our own country. The fact that any landowner in almost any state can loot to his heart's content, just as long as he is on his own land, is a national disgrace—America has weaker and more toothless antiquities laws than do most countries in Africa. And more important, the public must be awakened to what is happening. Up till now the operations of the antiquities business have been shrouded from public view, carried on within a small and slightly secretive circle of dealers, collectors, professors, and curators who have cut themselves off from the world at large as much by the obscurity of their language as by the necessity of protecting their enormously valuable collections. Before the antiquities trade can be properly controlled and cut down to size, all this must be opened up. Facts must be collected —no one at present has the slightest idea of the volume or profits of trade in archaeological antiquities. The public must be informed of these facts—what kinds of damage are being done; what things are being stolen; and what the consequences are of their innocent desire for bargains, their innocent pleasure in breaking petty foreign regulations, and their innocent fondness for using statues of ancient gods as living room decorations. And eventually, names must be named. All the talk in the world about unscrupulous dealers and rapacious collectors will have no real meaning until we can begin saying, in detail, what and where and who.

Field Museum's policy statement, printed in this issue of the *Bulletin,* is therefore only a modest beginning. More needs to be done. We want to cooperate with other institutions, and we seek the support of private persons, especially the Members of this Museum. The problem is urgent.

Bennet Bronson is Assistant Curator of Asian Archaeology and Anthropology at Field Museum.

Policy statement of Field Museum concerning acquisition of antiquities

1 (a) The Museum will not acquire any archaeological or ethnographic object that cannot be shown to the satisfaction of the Museum official or committee responsible for its acquisition to have been exported legally from its country of origin.

(*b*) Further, the Museum will refuse to acquire objects in any case where the responsible Museum official or committee has reasonable cause to believe that the circumstances of their recovery involved the recent unscientific or intentional destruction of sites or monuments. These restrictions shall also apply to archaeological objects excavated in the United States.

(c) "Acquire" shall include acquisitions through purchase, gift or bequest. "Country of origin" means both "country of ultimate origin," when the objects in question have been recently transported across several international boundaries, and also "country of intermediate origin," when applied to objects anciently transported and then deposited in an archaeological or historical context.

(*d*) This Museum policy shall be taken into account in determining whether to accept loans for exhibition or other purposes.

2 This Museum policy shall apply especially to objects of appreciable market value. The pedigrees of such items will be subjected to particular scrutiny. Regardless of value, however, no archaeological or cultural object of any kind will be acquired unless the responsible Museum official or committee is satisfied as to the legality of its exportation and the circumstances of its recovery.

3 The Museum will hereafter acquire no questionable objects except those that can be demonstrated to have left their country of origin before the approved date of this document. The same date shall apply as to the acquisition of objects reasonably believed to have been illegally or unscientifically excavated within the United States. The responsible Museum official or committee shall be entitled, however, to utilize the principles contained in this Policy Statement in determining whether to acquire any object reasonably believed to have been improperly exported or recovered before that date.

4 The Museum has for many years refused to appraise archaeological objects. Extending this policy, the Museum shall hereafter refuse to authenticate any antiquity the acquisition of which by the vendor or owner does not meet the criteria listed in paragraphs 1 and 3. In this manner the Museum hopes to avoid encouraging, even indirectly, the trade in illicit or irresponsibly recovered antiquities.

5 In the future, if the Museum should inadvertently acquire an object that is thereafter determined by the responsible Museum official or committee to have been exported or recovered in violation of this policy, the Museum shall promptly return the object to the transferor or, whenever appropriate, to the government of the country of origin or other proper owner thereof, as the case may be.

July 17, 1972

Men and their work

Donald Collier

Field Museum was a direct outgrowth from the World's Columbian Exposition of 1893, which celebrated the four hundredth anniversary of the discovery of America by Columbus. The first public appeal for extensive anthropological exhibits at the Exposition, which would serve as the nucleus for a permanent museum, was made by Frederic Ward Putnam, Curator of the Peabody Museum at Harvard, in a communication to the *Chicago Tribune* on May 31, 1890. He believed the fair offered a great opportunity to secure and display "a perfect ethnographical exhibition of the past and present peoples of America and thus make an important contribution to science, . . . which will be the first bringing together on a grand scale of representatives of the peoples who were living on the continent when it was discovered by Columbus . . ."

Dr. Berthold Laufer (at right) and friends in Hankow, China, about 1904.

The next year Putnam was appointed chief of the fair's department of ethnology. He made Franz Boas, then professor at Clark University, his chief assistant and head of the section on physical anthropology, and George A. Dorsey, one of his students at Harvard, head of the section on archaeology. He then plunged into organizing, through direct field work and negotiation with foreign governments, the most extensive anthropology exhibit of its kind ever assembled. He was also responsible for securing most of the natural history exhibits at the Exposition, including the great geology and zoology exhibition of Ward's Natural Science Establishment.

On November 28, 1891, in an address before the Commercial Club of Chicago, Putnam again urged the people of Chicago to take advantage of the opportunity afforded by the Exposition to found a great natural history museum. He outlined in detail the administrative organization of the proposed museum, the organization and activities of its scientific departments (Anthropology, Botany, Geology, and Zoology), and the nature of its exhibits. These proposals formed the blueprint of the future museum.

In November 1893, two weeks after the close of the fair, the Trustees decided to assemble the accumulating collections in the Fine Arts Building, which became the home of Field Museum until the move to the present building in 1921. The collections consisted of materials assembled and owned by the Exposition, which were presented outright to the new museum, and collections of private exhibitors, states, and foreign governments, which were obtained by gift or purchase. Franz Boas was appointed Curator of Anthropology and began work on the installation of permanent anthropology exhibits. The Field Columbian Museum was opened to the public on June 2, 1894.

At the time of the opening the anthropology collections consisted of approximately 50,000 specimens (the present collection contains over 400,000 specimens). Because of the theme of the Exposition, the majority of these pertained to the Americas. The scientifically most important collections had been gathered through field work carried out under Putnam's direction by about 100 persons during 1891 and 1892. Also included was the North American Indian collection donated by Edward E. Ayer, a founder of the Museum, plus other private collections purchased at the close of the Exposition, such as the Restrepo collection of prehispanic gold from Colombia, the Montez collection of Inca archaeological material from Cuzco, and the Hassler ethnographic collection from Paraguay.

A partial listing of geographical and tribal sources will give an idea of the scope of the anthropology collection in 1894. *Archaeology:* Alaska, Arizona, California, Michigan, New Jersey, Ohio (including the great Hopewell collection excavated by Moorehead for the 1893 Exposition), Wisconsin; Bolivia, Chile, Colombia, Costa Rica, Ecuador, Egypt, Guatemala, Ireland, Mexico, Peru. *Ethnography:* Alaskan Eskimo, Polar Eskimo of North Greenland (collected by Lt. Robert E. Peary for the 1893 Exposition), Siberian Eskimo, Apache, Assiniboin, Bella Coola, Chippewa, Haida, Kwakiutl, Malacite, Menominee, Micmac, Muskogee, Naskapi, Navaho, Ottawa, Pueblo Indians, Salteaux; Africa, Bolivia, Brazil, British Guinea, Chile, China, India, Japan, Java, Pacific Islands, Paraguay, Peru, Siberia, Venezuela (upper Orinoco).

The anthropology library began with a nucleus of 1,200 volumes that had been sent to the department of ethnology of the Exposition from various parts of the world in response to a printed circular distributed by Putnam.

Dr. Boas resigned under pressure as Curator of Anthropology early in 1894. The details of the crisis are not known, but there is evidence that it stemmed from a long-standing and bitter conflict dating back to 1891 between Putnam and Harlow Higginbotham, President of the Exposition and an influential Trustee of the new museum. Boas remained loyal to Putnam, his former chief and the man primarily responsible for laying the foundations of Field Museum. (Boas was out of a job for more than a year. Late in 1895 Putnam secured him the post of assistant curator at the American Museum of Natural History in New York. He began teaching at Columbia University and later started the department of anthropology there. It is intriguing to speculate on the course of American anthropology if Boas, who is generally considered the greatest of its founders, had remained at Field Museum and had taught at the young University of Chicago.)

Boas was succeeded by William H. Holmes, an archaeologist from the Smithsonian Institution. In December 1894 Holmes set out with Charles F. Millspaugh, Curator of Botany, on the Allison V. Armour Archaeological and Botanical Expedition to Yucatan and Mexico, which lasted four months. The party traveled with Armour on his steam yacht Ituna. Holmes visited various sites in Yucatan, assisted by Edward H. Thompson, U.S. Consul in Merida, who had made casts of Maya monuments for the Columbian Exposition and later secured important collections for Field Museum from Chichen Itza and Uxmal. Holmes also visited Palenque, Mitla, Monte Alban, the Valley of Mexico, and Teotihuacán. This work resulted in the addition of 1,000 archaeological specimens to the Museum's collections, including important Aztec sculptures and a unique engraved stone tablet from Teotihuacán (exported legally under Mexican laws of the period). Holmes published a now classic two-volume report, "Archaeological Studies Among the Ancient Cities of Mexico," illustrated by his superb bird's-eye-view drawings of Yucatecan sites, Palenque, Mitla, and Monte Alban (*Fieldiana: Anthropology*, vol. 1, no. 1, 1895 and 1897).

Holmes resigned late in 1896 to return to the Smithsonian Institution as chief of the Bureau of American Ethnology. His successor at Field Museum was George A. Dorsey, who had been appointed Assistant Curator the year before. (Dorsey, who received his Ph.D. in 1896 under Putnam at Harvard, was the first curator with a doctorate in anthropology. Boas was trained as a physicist; Holmes as an artist who came into archaeology after working for the U.S. Geological Survey as a field illustrator.) Dorsey held the post until 1915. During his incumbency the anthropology staff was

Dr. Fay-Cooper Cole and Philippine Negrito, on Luzon, 1909.

expanded and a very active field program was carried on among the North American Indians and in Oceania. Between 1908 and World War I, Fay-Cooper Cole and Albert Lewis, both Assistant Curators, assembled the Museum's great ethnographic collections from Melanesia and the Philippines, and Cole worked on a series of monographs on the Tinguian and neighboring Philippine tribes. Lewis later published a handbook on the peoples of Melanesia based on his three years in Melanesia. In 1909 Dr. William Jones was killed by Ilongot tribesmen in the Philippines while on a Museum expedition. He was the Museum's only American Indian staff member—Sauk and Fox—and also the only museum anthropologist to be so martyred.

Dorsey was succeeded by Berthold Laufer, who had been appointed Associate Curator in 1908. Laufer served as Curator until his death in 1934. He had received his Ph.D. in oriental languages from the University of Leipzig in 1897. Laufer was a sinologist who read and spoke Chinese and half a dozen European languages, and knew in addition Hebrew, Sanskrit, Pali, Malay, Japanese, Manchu, Mongolian, Dravidian, and Tibetan. He was a traditional German scholar of wide interests and great erudition. He conducted the Blackstone Expedition to Tibet and China (1908-10) and then the Marshall Field Expedition to China (1923), during which he acquired the basic part of the Museum's important collections of Chinese archaeological and ethnographic material and the outstanding Tibetan collection. His more than 250 publications included monographs, papers, and leaflets in the Museum's *Fieldiana: Anthropology* series and articles in English and German in numerous scholarly journals. Probably his most influential works, both published by the Museum, were "Jade: A Study in Chinese Archaeology and Religion" (1912, 370 pp.) and "Sino-Iranica: Chinese Contributions to the History of Ancient Civilizations in Iran" (1919, 446 pp.).

During the Laufer era the Anthropology staff was further enlarged, and besides Laufer's field work, there were extended Museum anthropology expeditions to various parts of the Americas and the Old World, which resulted in scholarly publications and important additions to the collections. A partial listing will convey the scope of the field work done by staff members during the period.

Fay-Cooper Cole—Indonesia and Malay Peninsula, ethnography (1922-23).

Henry Field—Europe, archaeology (1927-28, 1930); North Arabian Desert, archaeology and physical anthropology (1928); Near East and Soviet Union, archaeology and physical anthropology (1934); he also participated in three of the five field seasons of the Field Museum-Oxford University Joint Expedition to Kish (1923-30).

Wilfred Hambly—Angola and Nigeria, ethnography (1929).

A. L. Kroeber (Research Associate)—Peru, archaeology (1925, 1926).

Ralph Linton—Madagascar, ethnography (1925-27).

Paul S. Martin—Colorado, archaeology (four seasons, 1931-34).

J. Alden Mason—Colombia, archaeology (1922).

W. Duncan Strong—Labrador and Baffinland, ethnography and archaeology (1927-28).

J. Eric Thompson—British Honduras and Guatemala, archaeology and ethnology (1927, 1928-29, 1931, 1933-34).

Paul S. Martin was appointed Acting Curator after Laufer's death in 1934 and was given the new title of Chief Curator in 1936. The time was the depth of the Depression. Never again was the Museum able to fund numerous expeditions from its own income and gifts from private supporters. It was also soon after the beginning of the shift of the center of gravity of American anthropology from the museums to the universities. From 1935 to 1941 there were only four anthropology expeditions, and none during the four years the United States was in World War II. After the war, expeditions were resumed, but as operating costs rose and the endowment did not increase proportionately, the Museum depended more and more on research grants from private and governmental foundations. This change has resulted in new research orientations and the need for greatly increased lead time in planning field work.

During Martin's incumbency as Chief Curator (1934-1964) the Museum's geographical interests in anthropology did not change markedly, but on field expeditions there was much less emphasis

on collecting per se and much more on documentation and obtaining significant research data. Again, a partial listing will indicate the scope of field work.

Donald Collier—archaeology: Ecuador (1941-42), Peru (1946, 1956), Mexico (1949).

Phillip H. Lewis (University of Chicago Museum Fellow)—New Ireland, ethnography (1953-54).

Paul S. Martin—archaeology: Colorado (1937, 1938), New Mexico (12 seasons, 1939-55), Arizona (9 seasons, 1956-64).

George I. Quimby—archaeology: Michigan, Wisconsin, Minnesota (9 seasons, 1955-64), Louisiana (1949, 1954), Norway (1952).

Alexander Spoehr—Majuro, Marshall Islands, ethnography (1947); Saipan, archaeology (1949-50).

Kenneth Starr—Taiwan, archaeology and ethnology (1960).

Elaine Bluhm—archaeological survey of Cook, Du Page, and Lake Counties, Illinois (1954-56).

Dr. Ralph Linton with temple drum from Marquesas Islands, 1928.

In 1958 the Museum purchased from Captain A. W. F. Fuller his great collection of 6,500 ethnographic specimens from Oceania. This major acquisition was enthusiastically supported by Stanley Field. After Captain Fuller's death in 1961, Mrs. Fuller gave the Museum her husband's very important collection from Benin in Nigeria. This gift, combined with previous holdings, made Field Museum's collection of Benin materials next in importance to those in the British Museum and the Museum für Völkerkunde in Berlin.

Between 1941 and 1964 under Paul Martin's leadership, the Department of Anthropology completely reinstalled six American Indian halls and the halls devoted to Ancient Mesopotamia, Roman archaeology, Polynesia (incorporating the most important Fuller specimens), and Ch'ing Dynasty China; and a new hall of primitive art was created. This was the period of the gifted dioramist Alfred Lee Rowell, the Chicago painter Gustaf Dalstrom, and preparator Walter Reese. Together they formed a congenial and creative team which set the style of new anthropology exhibits for twenty years. This was also the time (1950-52) of the conversion of an exhibit hall on the ground floor to the unique Pacific Research Laboratory, with its excellent storage and study facilities for all of the Oceanic collections and a duplicate set of the 50,000 catalog cards. The space that was provided for future expansion later made possible efficient incorporation of the Fuller collection into the various Oceanic collections. The laboratory—PRL, as it is called—was a favorite project of Stanley Field.

Paul Martin became emeritus in 1964 and was succeeded by Donald Collier. Dr. Martin has continued to be active at the Museum and has maintained his archaeological field program in Arizona, supported by the National Science Foundation. This program has involved a field school for a dozen undergraduate students and an interdisciplinary research design in which hypotheses about ecological adjustments, settlement patterns, and social structure are tested by systematic sampling and statistical analyses with the aid of the computer.

Between 1964 and 1970 James W. VanStone conducted three archaeological expeditions to Alaska (1966, 1967, 1969) to investigate Eskimo culture change during the Russian and American periods, and Phillip H. Lewis spent a year in New Ireland (1970) in continuation of his museum and field research on New Ireland culture and art. Glen Cole excavated paleolithic sites in Malawi, Tanzania, and Zambia in 1966, and Fred Reinman spent a year excavating on Guam in 1965-66.

Staging a Festival of American Indian Art in 1968 and a Fiesta Mexicana in 1969 was a new departure for the Department of Anthropology and the Museum. The purpose of these festivals was to put the Museum into a meaningful relation with the 16,000 American Indians and the 120,000 Mexican-Americans in the Chicago area and to make better known to all the people of Chicago the cultural background and contemporary life of these important ethnic groups. There were special exhibits of both past and contemporary arts and crafts, photographic essays on the life of these people in Chicago, live artists and craftsmen at work, performances of dancing and singing, lectures and movies, and a sales area where high quality contemporary arts and crafts could be purchased. These events were made possible by generous financial support from private and government foundations, government agencies in the United States and Mexico, and Air Canada and Mexicana Airlines; by the loan of exhibit materials from individuals, museums, and government agencies; and by the enthusiastic support of the Chicago Indians and Mexican-Americans. Each festival, under the general direction of Donald Collier, took a year to plan and arrange and a major effort on the part of the Museum staff to bring off. Their success in terms of response of the people of Chicago, including the Indians and Mexican-Americans, seems to have justified these efforts.

Establishment of a centralized Department of Exhibition was another development of this recent period, followed by staging of numerous special exhibitions and the beginning of planning for overall revision of the Museum's permanent exhibits. Since Anthropology has more than twice as much exhibit space as any other department and has been involved in the greatest number of special exhibitions, these changes have had more impact on it than on the other scientific departments. Obviously, considerable curatorial energy and time have had to be diverted from research to these new and stepped-up activities.

James VanStone became the first Chairman of Anthropology in January 1971. This new system of rotating chairmanships, which replaced the old chief curatorships, was in line with the desires of the curators and is consonant with the previously established system of standing committees of the scientific staff whose functions are to investigate problems and make policy recommendations to the Museum administration and the scientific departments.

All of these changes have moved the Museum a long way from a traditional cloister of research. They are on the whole healthy and they are necessary for the future development of the Museum.

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Dr. Donald Collier is Curator of Middle and South American Archaeology and Ethnology at Field Museum.

HOW I RISKED MY LIFE FOR ARCHAEOLOGY

SUSAN MOORE

In September of last year I came to Field Museum in hopes of working as a research student in the Department of Anthropology with John Terrell, who had just been appointed Assistant Curator of Oceanic Archaeology and Ethnology. John had recently returned from the South Pacific after more than a year of field work on the island of Bougainville in the Solomons. I had heard through the Women's Board of the Museum that he was looking for student volunteers to help him with the laboratory analysis of almost seven tons of archaeological specimens from ancient village sites on the island.

Any doubts about my qualifications as an archaeologist were soon diminished after talking over what I might do in the Department of Anthropology under John Terrell's supervision. He pointed out that if I could read at home and take things in careful steps, there was a good chance I could accomplish at least two things: discover what it was like to analyze and interpret the evidence recovered from field excavations and, perhaps more important, learn something about the demands and pitfalls in the scientific study of man. We agreed that I would be responsible for one archaeological site, beginning with washing each artifact discovered there and ending with writing a paper on my findings and conclusions about the site.

Popular books on archaeology often fail to give the reader a clear understanding of what must be done to turn the objects recovered from an excavation into hypotheses and conclusions about the past. I am sure many people have read about how carefully an archaeologist must excavate an ancient site. But how many of us know what happens back in the archaeologist's laboratory before he or she can sit down and write books and articles?

For my first two months at the Museum I sat at a sink washing small fragments of ancient clay cooking pots from my study site, called "Tearaka" (a name which means "abounding in stones" and refers to the cobble beach in front of it). I loved it. I wore a lab coat to establish myself as an integral part of the Bougainville Archaeological Survey and slowly scrubbed the skin off both hands. I knew that somebody had to wash the specimens before they could be properly labeled. As John reminded me, we had agreed I was to have an experience from soup to nuts; or at least from sink to laboratory table! I checked around the Museum to see if a *real* archaeologist would wear rubber gloves; and when I discovered that you could get them from the supply room, I ordered myself a pair.

After all the washing was completed came many long hours of labeling individual potsherds to establish forever their archaeological provenance. Then one day when I had worked my way through several trays of specimens with pen and india ink—and was feeling well on my way to scientific greatness—John casually left a red felt-tipped pen on my desk with a note to come and see him when I had time.

He complimented me on my numbering style. And then, looking me straight in the eye, told me that each piece would need yet another number. My india ink numbers established each piece as a specimen from Tearaka and from a definite archaeological layer at that site. The number I would add with the red felt-tip would establish each sherd as an *individual* piece of pottery from a particular layer. It soon became obvious that *I* needed an assistant. When my friend and neighbor Sue Sanchez agreed to help once a week, I was delighted.

In January I finished numbering my potsherds and it was time to move on to the next step: scientific analysis. John spoke of it often. He rather mysteriously called it "turning evidence into information." Clearly something was needed, because all I had on the laboratory table in front of me were trays of very clean artifacts which had been numbered twice. The problem of saying something coherent about thousands of potsherds looked immense. Where do you even begin?

From September through January I had been preparing for this next step. I had read John's doctoral dissertation and several of his reports on the Bougainville Archaeological Survey, numerous books and articles on the archaeology and ethnography of the South Pacific, on pottery making, and on methods of research, and I had struggled through a statistics book. John was always available to explain and clarify and to discuss the problems I was encountering in trying to grasp the information I would need to conduct a study of my potsherds and then to formulate ideas about the prehistory of Bougainville.

Armed with callipers and other instruments for measuring, my dog-eared statistics book, and a lot of paper, I labored through June of this year measuring, counting, and describing. Gradually the artifacts did begin to fall into place and I was able to develop a system for describing them scientifically.

When I first sat down to sort my specimens into piles of things that looked most alike, it was apparent that I had two different classes of pottery vessels. The sherds in one pile looked very much like vessels known to have been manufactured on the small island of Buka, just north of Bougainville, whose almost 2,000-year-old pottery tradition has been described by James R. Specht of the Australian Museum in Sydney. The sherds in the second pile appeared to be identical in most respects to the kind of pottery vessels manufactured

on the southeastern coast of Bougainville in the vicinity of the modern town of Kieta—one hundred miles from Buka and forty-five miles south of my site at Tearaka. Since one could safely assume that the people of Buka and the people at Kieta did not travel to Tearaka to discard broken pots at the communal dump there, the occurrence of both kinds of pottery ware seemed to indicate that prehistoric Tearaka had been a village where two separate trade networks came together. In support of such an inference, it is known historically that in the earlier decades of this century traders from both Buka and Kieta did reach Tearaka and neighboring villages and that they brought with them modern cooking vessels for trade.

According to the results of Dr. Specht's archaeological investigations on Buka Island, the art of pottery making has been practiced there since the last centuries before the birth of Christ. Unfortunately, the prehistory

of the Kieta region of Bougainville has not yet been explored. Nevertheless, the discovery of broken cooking pots at Tearaka from both centers of manufacture makes it possible to arrive at some idea of the antiquity of trade from Kieta by noting when Kieta pots, of unknown antiquity, are found in the ground at Tearaka with Buka pots, whose age and history have been established by Dr. Specht's own excavations.

To judge from my work on the Tearaka site, it now seems that pottery trade from Buka reached Tearaka and the east coast of Bougainville sometime after A.D. 1000. Buka traders *may* have arrived on the east coast well before that, of course, but there is no evidence at Tearaka itself to support that possibility.

Now this discovery is quite important for the prehistory of Bougainville. Scholars have long believed that pottery making was introduced to the Kieta area by migrant peoples from the Shortland Islands south of Bougainville during an invasion about 1860. For several theoretical reasons, John has questioned the idea that foreigners invaded the island scarcely more than a hundred years ago. Tearaka confirms his suspicions.

All the evidence from Tearaka indicates that trade in cooking pots from Kieta is at least as old as that from Buka, because all the archaeological layers that have yielded Buka potsherds have also given up sherds from vessels that most surely came from Kieta. Such evidence may not alone disprove the notion that there was a foreign invasion from the Shortlands in the last century. There is little doubt, however, that pottery making was not introduced to Kieta by the hypothetical invaders. In fact, the Kieta cooking pots closely resemble the vessels made in the Shortlands. This similarity indicates that the history of contact involving Tearaka, the Kieta region, and the Shortland Islands dates back centuries before the alleged 19th century invasion.

To help establish these hypotheses, it was necessary for me to examine each one of hundreds of distinctive potsherds from several different angles. Each sherd was measured in numerous ways. The decorative elements were described and classified. Variations in shape were noted and tabulated. Then I had to test the statistical significance of the results. The phrases John used so often—"describe the similarities and differences," "is that significant?" "establish scientifically," "turn evidence into information"—really began to mean something to me for the first time.

Initially I was the only continuing research student working with John Terrell. During the winter months, however, nine other students from universities in the Chicago area joined the study program that John and I had devised. In February of this year Ben Bronson, the newly-appointed Assistant Curator of Asian Archaeology and Ethnology, returned from a lengthy archaeological reconnaissance trip through Indonesia. Soon five students also joined the research program to help him evaluate the many Asian exhibits in the Museum, some of which date from an early era of museum display and are in great need of revision.

With the arrival of so many new people in the Department of Anthropology, it became all too obvious that we needed a well-equipped laboratory where we could coordinate our efforts. We were scattered here and there in the anthropology halls on the third floor wherever there happened to be an empty table and a chair.

John drew up plans for a laboratory to be located in a little-used office in the anthropology wing of the Museum. The Museum administration swiftly approved the plans. In a few days carpenters and electricians were at work painting walls, adding electrical outlets and new lights, building storage units, and refinishing the floor. In May the Research Laboratory for the Program in Archaeology and Ethnology was officially opened and the Department made public the news that the Program itself, initiated back in September of 1971, would be a regular offering to students in Chicago.

By the end of June I was beginning to see more clearly some of the important conclusions that could be drawn from my study collection.

It was also in June that I came close to losing my life for archaeology.

On the morning of the 6th I went out to my car to drive my children to their sitter before going on to the Museum. I placed my notebook on the luggage rack on the roof to have both hands free to fasten my youngest child into his traveling seat. Absent-mindedly I left the notebook there and drove off with the children and a friend, Carol Carr, safely inside. On Lake Shore Drive disaster struck. Cars behind us for some reason started honking continuously. Somewhat irritated, I checked the rear-view mirror again. A peculiar thing. There was white paper fluttering all over the Drive. I immediately realized that nine months of carefully extracted information about Tearaka had taken wing from the top of my car.

Linoleum block cuts by Zbigniew T. Jastrzebski.

For an hour and a half Carol and I placed our lives on the line as we darted back and forth between eight lanes of rush-hour traffic grabbing sheets of notebook paper from under the wheels of passing vehicles. When we finally staggered into the Museum, Marty Zelenietz, a fellow student researcher, solemnly placed my battered notebook next to a bronze plaque that had just been brought from the basement to the Research Laboratory: a plaque in memory of William Jones, an ethnologist who had lost his life in the Philippines in 1909 while collecting specimens for the Field Museum (see *Field Museum Bulletin*, September 1971).

I was, fortunately, luckier than Dr. Jones. Not only was I still alive, but when I sat down to examine the damage, I discovered that Carol and I had made almost 100% data retrieval. From then on I would keep a promise to John, made scarcely a week earlier. I would Xerox my notebook "in case anything ever happens."

July and August were months of final analysis and writing for me. Now a whole year has passed at the Museum and I have produced my report on the Tearaka site, soon to be published along with reports by other students, as one of the "Reports of the Bougainville Archaeological Survey."

What I learned at the Museum during the year I spent there sounds like a list of regular classroom college courses for an anthropology major: statistics, methods of research, geography, Pacific archaeology and ethnology. However, these subjects were more meaningful to me than they would have been if I had learned them in the regular way, because I *used* them as tools. Courses taken at a university only rarely have the impact of the ones I "took" at Field Museum, which grew out of an authentic need to conduct all phases of a rigorous scientific investigation.

Susan Moore is an anthropology student in the University Without Walls program at Northeastern Illinois University.

an african potter at work

maude wahlman

Pottery is an important aspect of African culture. It is made and used in almost every tribe, usually by women, less often by men. In an effort to communicate something about African culture, Field Museum recently sponsored a demonstration of traditional African pottery making by the Nigerian potter Ladi Kwali.

Ladi Kwali's first name means "born on Sunday"; her second name is simply that of her home, Kwali, one of the villages of the Gwari people of northern Nigeria. As a child she was trained in traditional Gwari hand-building pottery methods by her aunt. As a young woman she was taught to throw pots on a wheel by the English potter Michael Cardew.

Michael Cardew went to Nigeria in 1950 as a senior pottery officer working for the British Ministry of Industry and Trade. He established a pottery training center at Abuja after much research in northern Nigeria. Abuja was chosen for several reasons: the traditional pottery in the area was excellent; firewood was abundant; good clays were plentiful; there were good local sources for the raw materials necessary to make glazes; and water was available. At Abuja, Cardew taught Nigerians and other Africans to throw pots on a wheel and to use stoneware clay and glazes.

However, he was so impressed with the local Gwari pottery, especially that made by Ladi Kwali, that when she came to learn new methods at the training center, Cardew encouraged her to continue making traditional pots also. She was famous as a traditional potter when Cardew came to Nigeria, and he simply taught her and other native potters how to adapt traditional pots to stoneware clay, which could be glazed and fired to high temperatures.

Ladi Kwali's traditional waterpots actually kept the center going in its early years when some people in the Ministry of Industry and Trade thought it was not profitable and should be shut down. The enthusiasm with which Ladi Kwali's pots were received when exhibited in London in 1958, 1959, and 1962 helped keep the center open. In 1962 Ladi Kwali spent three weeks in England demonstrating her craft to audiences of potters, students, and ethnologists. In 1963 she was invited to go on a tour of demonstrations in Germany and Italy.

In October 1965 Ladi Kwali achieved additional international recognition in the ceramic world when she won a Silver Award of Excellence for a jar with a traditional pattern which had been entered in the 10th International Exhibition of Ceramic Art at the Smithsonian Institution in Washington,

The Ghanaian potter Kofi Athey explains to Christine Danziger, conservator in the Museum's Anthropology Department, certain technical details about African ceramics.

Ladi Kwali making a traditional Gwari waterpot at Field Museum. She rolls about three clay sausages at one time and lays them in the bottom of the pot until she is ready to add one to the pot.

At this stage Mrs. Kwali is building up the shoulder of the pot by pressing on some of the clay sausages. After each addition of clay she smooths both the inside and the outside of the pot with a tool made from a piece of gourd, which obliterates the marks of the newly added clay and incorporates it into the wall of the pot.

D.C. The jar was brought to the United States by the Harmon Foundation of New York City, and they agreed to leave it on permanent exhibition with the African ethnological collection at the Smithsonian.

Michael Cardew arranged a United States tour for Ladi Kwali in 1972 to major cities on the East Coast and in the South and to Chicago, Los Angeles, and Dallas. The three people in the tour were Ladi Kwali, Michael Cardew, and Kofi Athey. Kofi Athey is a Ghanaian potter who also studied under Michael Cardew at Abuja, and he is now in charge of his own pottery center at Jos, Nigeria. On May 17, 1972 Ladi Kwali made a traditional waterpot on the terrace outside the west door of Field Museum while Michael Cardew answered questions and talked informally about Nigerian pottery and Kofi Athey prepared the clay and translated for Ladi Kwali. About 450 people came to see the demonstration, some from as far away as Urbana, Illinois and Bloomington, Indiana.

The photos show progressive stages in the building of this pot. It is the kind traditionally used in Gwari to transport water from its source to a larger storage waterpot which is kept in most African homes.

After the pottery demonstration, Michael Cardew introduced a new film, "Abuja Pottery," made at the Pottery Training Center by the Australian film maker Alister Hassam. Field Museum will acquire a print of this film for future educational purposes. The film shows Ladi Kwali and another traditional Gwari potter making hand-built pots alongside men throwing pots on a wheel. It also shows traditional Gwari firing methods as well as contemporary firings at Abuja. Traditional Gwari pots are fired by making a circle of stones, laying thin sticks on the ground, carefully piling the pots on the sticks, and covering them with broken potsherds and brushwood and grass. The fuel is lit and the pots are fired for not longer than three hours. Sometimes the pots are basted after firing, while hot, with a liquid made from soaked locust bean pods. This treatment gives the pottery a mahogany-colored surface which looks almost like a glaze.

Traditional African pottery is often burnished but is never glazed. In order to glaze a pot it must be made of clay which can be fired to a high temperature so that the clay minerals will bond with the glaze. Some scholars had assumed that African potters could not achieve high firing temperatures. Michael Cardew discovered and explained in his book *Pioneer Pottery* that Africans deliberately use low-firing clays and no glaze. African pots are made mainly to be used for cooking over an open fire. A pot that is used in this way must be highly resistant to thermal shock—that is, it must not be fired to a temperature high enough to melt the clay minerals into a rigid glass state.

African pots are deliberately made of clays that fire best at about 600°C., leaving the pots in a non-glaseous, porous state with the clay minerals still physically flexible, and thus the pot is resistant to the thermal shock caused by cooking over an open fire. When the pot is placed over a fire, the clay minerals on the outside of the pot react to the intense heat by expanding into the pores. When it is removed from the fire, the minerals cool and contract back into place without cracking the pot. A glazed pot subjected to such extreme conditions would crack. Porous pots also make excellent waterpots because they can sweat and thus cool the water inside by evaporation.

Although Michael Cardew retired from Abuja in 1965 to Cornwall, England, the Abuja Training Center, now operated by the Nigerian government, continues to train Nigerians in pottery-making technologies. All materials used are from Nigeria. After the trainees have mastered the various aspects of making pottery, they may remain at the center and produce pottery and teach

Shaping the neck of the pot with fingers and the palm of the hand.

The clay just added here is not in a smooth coil but has been pinched over the neck for the wide lip that will be shaped next. Mrs. Kwali is answering a spectator's questions with the help of Michael Cardew, who is translating back and forth between English and Hausa.

Mrs. Kwali uses a piece of wet leather to form the lip of the pot. This is the hardest step in making a traditional African pot and is more time-consuming than any other stage except decoration.

new students or they may start a new workshop elsewhere. There are now Abuja-trained potters at centers in Kampala, Uganda and Jos, Nigeria.

The products of the Abuja Pottery Training Center are an example of an evolving African art. The traditional terracotta pottery used in villages is evolving into ceramic ware made to be used in cities. The traditional pots were, and still are, used in African homes for cooking over an open fire; for storing water, food, and fuel; for carrying liquids and food; and in shrines to hold ritual liquids used in ceremonies. The contemporary pots—both those made on a wheel and those built by hand, bisque-fired, glazed, and again fired—are sold to upper-class Nigerians and Europeans in Nigeria and Europe as tableware and decorative pieces. The products made at Abuja are glazed stoneware oil jars, traditional waterpots, flowerpots, ashtrays, casseroles, tumblers, bowls, mugs, plates, teapots, coffeepots, and cups and saucers. There are plans to sell Abuja pottery in Chicago also.

As much as one admires traditional African pottery, one must recognize the validity of an art form that is evolving to meet new needs, whether the evolution be technological (use of the wheel, stoneware clays, and glazes), economic (exportation of African pottery to other countries), or social (the emergence of a new social class with different ceramic needs).

Africa is changing, just as most parts of the world are changing. Some people lament the changes but still admire what Michael Cardew has achieved, because at Abuja the traditional high level of craftsmanship and design has been continued and adapted to other clays and techniques. Ladi Kwali's traditional waterpot constructed here at Field Museum was made with stoneware clay donated by the A.R.T. Studios in Skokie, Illinois and fired at the Art Institute of Chicago by the Evanston potter James Lorio. But its shape and designs are the same as her pots made at Kwali—the native animals, the chameleons, lizards, snakes, scorpions, birds, fish, and crocodiles. It is now a part of the African collections at Field Museum.

The United States tour of Ladi Kwali, Michael Cardew, and Kofi Athey was cooperatively sponsored through the African Craftsmen in America, the American Crafts Council, and the World Crafts Council as an experiment in international understanding between peoples. Its success will enable other African craftsmen to come to the United States.

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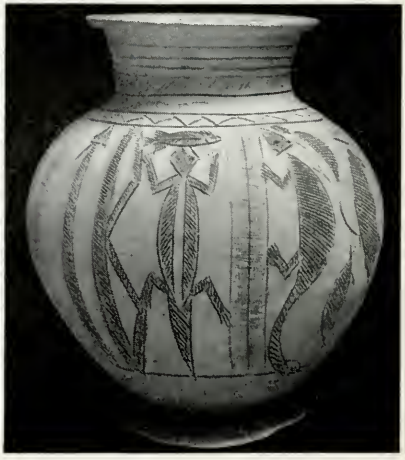
Mrs. Maude Wahlman is Consultant in African Ethnology at Field Museum.

The waterpot now in its final shape, Mrs. Kwali rolls a carved wooden tool called a roulette over the side of the pot. She uses another roulette, of twisted cotton, to impress decoration on the shoulder of the pot. The twisted cotton roulettes are made by women; the wooden roulettes, carved with a pattern of simple notches, are made by men and sold to the potters. Potters use several roulettes, each with a different design. Many African pots are rouletted all over. The potters say rouletting is for decoration, but Cardew and other scholars have noted that the process consolidates the surface, strengthens the pot, and assists in cooling any liquid contents by increasing the surface area through which evaporation may take place. Rouletting also gives a pot a non-slippery surface which is useful when a woman with wet hands tries to lift a pot full of food or water. In the audience are Ruth Duckworth, a famous Chicago potter, and a photographer from the *Chicago Daily Defender.*

The finished pot shows the same animal designs that Ladi Kwali has always put on her traditional pots—crocodiles, lizards, snakes, chameleons, birds, fish, and scorpions. At the Abuja Training Center the large waterpots that Mrs. Kwali makes of stoneware clay are bisque-fired, then painted over with a mixture of kaolin and feldspar. This is rubbed off with a wet sponge, leaving white slip lodging in the incised designs. The pot is then dipped in a special glaze which when fired is transparent rather than opaque. After firing, the designs appear as if inlaid in white and the background is a deep green or gray.
Photos by Fred Huysmans and Hilda McElroy.



PEOPLE WHO STUDY PEOPLE

WHO'S WHO IN ANTHROPOLOGY

Elizabeth Munger

Anthropologists do a bewildering variety of things because anthropology, as the "natural history of man," encompasses the study both of man's origins and of the great diversity of cultures he has created. At Field Museum the responsibilities within the Department of Anthropology are divided primarily by geographical area, and most of the curators are concerned with the present as well as the past of the areas they specialize in. That is, they are ethnologists as well as archaeologists. But recovering, recording, and preserving evidence of the immense diversity of human experience are only the beginnings of their work. Their goal, like that of all anthropologists, is to find explanations of this diversity—to unravel the varying roles of the natural environment, of social conditions, and of the individual psyche in producing the cultures of mankind.

Dr. James W. VanStone has three major responsibilities at Field Museum. He is Curator of North American Archaeology and Ethnology, Chairman of the Department of Anthropology, and scientific editor of the *Fieldiana* series of publications. Before he joined the staff in 1966 he taught for fifteen years, first at the University of Alaska, then at the University of Toronto. Dr. VanStone is an authority on the peoples of the North American arctic and subarctic, where he has done extensive fieldwork. He spent the winter of 1955-56 with Eskimos at Point Hope, Alaska, participating fully in their whaling and sealing expeditions. The winter of 1960-61 he lived with the Chipewyan Indians in the Canadian Northwest Territories. This past summer he spent in southwestern Alaska pursuing his current research interest in how the early Russian and American activities in that region influenced the culture of the Eskimos. His extensive knowledge of this area makes him a valuable member of a federal government watchdog committee to see that environmental protection measures are carried out in connection with building the trans-Alaskan oil pipeline. Dr. VanStone is especially anxious that no archaeological sites are disturbed.

Dr. Paul S. Martin, the distinguished Chief Curator of Anthropology for thirty years and emeritus since 1964, can by no means be considered retired. He has hardly changed his rigorous schedule, established long ago, of summer archaeological field work in the Southwest and winter laboratory analysis and writing in his third floor office. However, he changed drastically the goal and product of that work about ten years ago. He was dissatisfied with his renowned achievements of thirty-five years because "they were not explaining, predicting, or clarifying cultural phenomena; they were not concerned with contemporary problems of behavioral science . . . and they were not helping man to understand and to interpret his world." So he wrote in his article "The Revolution in Archaeology" published here last year. His work is now guided by the conviction that archaeologists must view their evidence as expressions of recurring cultural processes. He is using computer analysis to seek regularities of cultural change and adaptation. The Kidder Award Dr. Martin received in 1968 "for achievement in American archaeology" was as much in honor of his current as his past work. Students count themselves fortunate to be selected to participate in his formal summer teaching and excavation program at the Museum's Arizona field station. This program has been funded since 1964 by National Science Foundation grants.

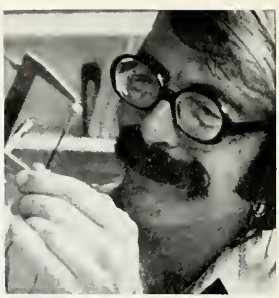
Dr. Donald Collier, Curator of Middle and South American Archaeology and Ethnology, was probably the only undergraduate student in 1932 to have a research paper become part of the Congressional Record and even influence government policy. It was on peyote and the Indian peyote religion, prepared at the request of his father as background information for the Senate Committee on Indian Affairs. It also influenced the author, for it led him to choose anthropology as a career. Since 1941 Dr. Collier has pursued his interest in both the past and present of Indian America at Field Museum, with the added administrative responsibilities of Chief Curator of Anthropology between 1964 and 1970. The many fellowships and grants he has been awarded over the years to further his work are recorded many places, as is his long bibliography of research reports, conference papers, and popular articles (44 in this magazine alone). But another highly significant contribution to science may have been recorded only here. Dr. Willard Libby, inventor of the carbon 14 dating technique, wrote last year that "it was Dr. Collier who developed the technique of persuading museum keepers that they should give us materials to measure. This was no small achievement since our method is destructive."

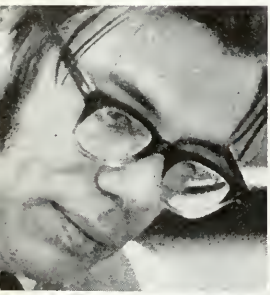
Dr. Phillip Lewis, Curator of Primitive Art and Melanesian Ethnology, didn't even know there was such a subject as anthropology, let alone that Field Museum had a department devoted to it, until after World War II and he returned to the Art Institute to complete his B.F.A. in drawing, painting, and illustrating. He discovered the discipline through a teacher who made it so fascinating that Lewis decided to go on to graduate school and study it full time. He had learned by this time that the problems of an artist in society are great, and he decided to continue study about art rather than practice it. Anthropology offered the framework for him to examine the forms and functions of art in smaller, simpler societies than our own. Two University of Chicago Museum Fellowships enabled him to become familiar with the vast collections here. In 1953 Phil Lewis went to Oceania to investigate the social context in which some of the materials he had been studying were created and used. In 1957 Field Museum established a curatorship of primitive art and Lewis was appointed to the post. He assembled almost single-handedly our now well known hall of primitive art. A National Science Foundation grant allowed Dr. Lewis to revisit New Ireland in 1970. He found that both the forms and the religious context of the art, though changed, showed more persistence than he had expected.

Many of the Museum's actual specimens as well as cast duplicates of ancient man and his artifacts are in the office of Dr. Glen Cole, Associate Curator of Prehistory. Their ages range from about 10,000 to roughly 2,000,000 years old. Most of them are from Africa, and many were excavated by Cole himself, in Uganda, Tanzania, Malawi, and Zambia. These bits of bone and stone do not look remarkable or even interesting to the untutored eye, but they constitute evidence of the early anatomical and cultural evolution of man. Dr. Cole has been working particularly on computerized analysis of materials that represent the demise in Africa of the Acheulian stone-working tradition, which persisted through more than 500,000 years. This tradition was then rather abruptly replaced by diverse new stone tool industries. The problem he is working on is, how and why did these rapid ancient culture changes happen? Dr. Cole has been a member of the staff since 1965, but he first worked here as a graduate student when he held a University of Chicago Museum Fellowship in 1955. In between he has been chased by elephants, but not caught; haunted by a lion, which gave up; and hissed at by a twig he was

Left to right:
Mrs. Agnes Fennell
Mr. John Terrell
Dr. Paul Martin

Left to right:
Dr. Glen Cole
Mr. Christopher Legge
Mr. Bennet Bronson

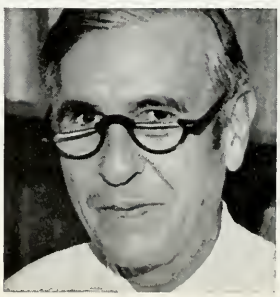




Left to right:
Dr. James VanStone
Miss Joyce Korbecki
Dr. Hoshien Tchen

Left to right:
Mrs. Ruth Andris
Mrs. Christine Danziger
Miss Lenore Sienczka

Left to right:
Mrs. Maude Wahlman
Dr. Donald Collier
Dr. Phillip Lewis
Photos by Ed Jarecki



about to pick up and throw into a fire. He has also been bitten by anopheles mosquitos and never got malaria, and by tsetse flies and never come down with sleeping sickness. An ideal field man.

John Terrell joined the Anthropology staff just a year ago as Assistant Curator of Oceanic Archaeology and Ethnology. He came directly from graduate work at Harvard University; indirectly from excavating in New Zealand, Samoa, and Bougainville and lecturing on prehistory at the University of Auckland. He says that at the age of five he wanted to be a paleontologist but decided at twelve to dig tombs in Egypt instead. Now he is most interested in pursuing archaeology as an explanatory discipline within which to study human bio-geography —the spatial distribution and behavior of human populations. More about what that involves can be found elsewhere in this issue in the adventure story of one of his student assistants.

Our Assistant Curator of Asian Archaeology and Ethnology, Bennet Bronson, who also joined the staff about a year ago, studied medieval history and literature at Harvard before switching to graduate work in archaeology at the University of Pennsylvania. He has dug in England, Guatemala, Turkey, Iran, Thailand, Ceylon, and even Pennsylvania. A recent reconnaissance trip to Southeast Asia was to prepare the way for an important excavation project in Java which has as one of its goals the training of Indonesian archaeologists. Ben Bronson is particularly interested in early agricultural sites and evidence of contact with the more advanced Indian and Chinese civilizations. Meantime he has organized a group of volunteers and undergraduates from local universities to help him in recataloging, inventorying, and evaluating our Asian holdings.

Dr. Hoshien Tchen brought the enormous learning and experience of an international scholar, educator, and diplomat to his current "retirement career" as Consultant for the Museum's East Asian collection. In 1921 he was awarded the degree of *Docteur en droit* from the University of Paris. He has been a professor at the National Law College in Peking; a member of the government of his native Kiangsi Province as well as commissioner of justice and commissioner of education; and secretary-general of the Chinese National Committee on Intellectual Cooperation for International Organizations. In 1950 he came to the United States. At Field Museum he first helped establish the fine East Asian library and then began work on cataloging the large, comprehensive collection of Chinese ink rubbings gathered by Berthold Laufer. This project, now nearing completion, could have been undertaken by few other people. It has required identifying, dating, and locating the objects from which the rubbings were made as well as translating the inscriptions into English, identifying the pictorial elements, writing explanatory notes, and citing reference material in both eastern and western languages. The catalog will be a major tool for further East Asian research.

Last year Maude Wahlman held a Wenner-Gren Foundation museum research fellowship to catalog and analyze 200 pots she collected in Nigeria in 1970. She was visiting Yoruba villages to survey traditional methods used by potters today. The data are for her dissertation on Yoruba pottery for Northwestern University, where Mrs. Wahlman is a Ph.D. candidate. Now, under a grant from the National Endowment for the Arts, Mrs. Wahlman is Consultant in African Ethnology and planning a 1973 exhibit in the Museum of contemporary African arts. It will display a wide range of textiles, pottery, jewelry, painting, block printing, etching, music, architecture, and dance. She is eager that authentic contemporary African work become more widely known, especially because so much so-called "airport art" from Africa has spread across this country in recent years.

Though the curators are formally responsible for the specimens and their documentation, the collections are far too large and complex to be organized and cared for without technical assistance from the department's Custodian, Conservator, and Restorer.

Christopher Legge, Custodian of Collections, knows exactly where and what any of the 400,000 anthropology specimens are. But he knows a lot more than that about them, thanks to a perpetual curiosity, a large personal library of old books, and a world-wide network of correspondents. In his earlier career he legitimized an addiction to adventure, first by choosing history as his subject at Cambridge University, then by serving as a British Colonial Service officer in Africa and the Fiji Islands. Now he finds material galore to feed this habit in the human but not necessarily ethnographic histories of many of the specimens. Sometimes he can be persuaded to write about them for us. Mr. Legge is a much sought-out man, by both scholars and fellow addicts.

Christine Danziger, Conservator, calls herself the "interpreter of the needs of the materials." Her workshop is the Robert R. McCormick Conservation Laboratory, a group of large, spotless rooms on the third floor, efficiently furnished with a complete reference library and almost every piece of equipment imaginable to analyze and document the chemical and physical nature and condition of any specimen in our enormously large and varied anthropological collections. It is a perfect lab for its purpose because Mrs. Danziger, who has degrees in chemistry and physics, designed it herself with the help of Dr. Collier and Dr. Lewis. That was just ten years ago, when she came to the Museum from the University of Chicago biochemistry department. She chose carefully and handles expertly every piece of equipment in the lab, from an X-ray machine and $7,500 microscope with micro-melting stage to a ceramic-bead polisher, drill press, glue gun, and flameless heat torch. Those are just some of the technological aids necessary for her to make full use of her knowledge and skills in carrying out the first and last responsibility of the Museum—conservation of its collections. As Mrs. Danziger points out, that can be done only by studying the chemical and physical composition of the specimens and treating them accordingly. Then they can speak for themselves truly, now and to future scholars, about the cultures that produced them.

Mrs. Ruth Andris has done many things for the Museum over the years. Presently she comes in part-time to do restoration and mending of specimens as needed. She is a sculptor whose work can often be seen in the rental and sales gallery of the Art Institute of Chicago as well as many other galleries. There are also four unsung heroines of the Anthropology Department: Miss Lillian (Terry) Novak, departmental secretary; Miss Joyce Korbecki, scientific assistant; Miss Lenore Slenczka, secretary; and Mrs. Agnes Fennell, Dr. Martin's secretary. The not even named heroes and heroines are many volunteers who give much time and service to anthropology.

Elizabeth Munger is Editor of the Field Museum Bulletin.

Gordon Bent, partner, Bacon, Whipple & Co., is chairman of the finance and investments section

James R. Scanlin, president, General American Transportation Corp., is chairman of the transportation and fuels section.

Robert G. Biesel, president, International Division of General American Transportation Corp., is co-chairman of the transportation and fuels section.

James J. Condon, executive vice president, The Peoples Gas, Light and Coke Co., is chairman of the general service section.

Richard H. Needham, executive vice president, Needham, Harper & Steers Advertising, Inc., is chairman of the advertising, publications, printing and graphic arts section.

Introduced here are some of the top executives of major companies who are carrying leadership responsibilities for the corporate gifts division of Field Museum's $25 million Capital Campaign. Each one represents a special segment of the industrial, business, and professional activities of the Chicago area.

With their leadership, the corporate gifts division team is now launching the first phase of its efforts. Members of the team are personally visiting over 1,200 Chicago area firms to explain Field Museum's capital improvement needs. Pledges extending over three to five years are being requested.

Both the numbers and the needs of the public which the Museum serves have increased greatly in recent years. More and more people are making use of the formal and informal education and enrichment the Museum has to offer. As the Museum has extended itself over the years to keep pace with its responsibilities to the general public as well as to the scientific community it also serves, it has had to defer many capital expenditures. They can be deferred no longer.

This purpose of the Capital Campaign is one readily understood by business. The funds are urgently needed for renovation, major maintenance projects, and modernization of the Museum's now 52-year-old building.

Blaine J. Yarrington, president, American Oil Company, is chairman of the corporate and foundation gifts division.

David W. Rewick, partner, Ernst & Ernst, is chairman of the professionals section.

Richard M. Morrow, executive vice president, Amoco Chemicals, is chairman of the chemicals and electronics section.

Charles F. Murphy, Jr., partner, C. F. Murphy Associates, is chairman of the construction industry section.

Raymond N. Carlen, president, Joseph T. Ryerson & Son, Inc., is chairman of the metals and machinery section.

John Lind, executive director (retired), Standard Oil of Indiana and American Oil Foundations, is campaign consultant.

FIELD BRIEFS

NSF Grant for Scanning Electron Microscope

Field Museum has been awarded a grant of $70,000 from the National Science Foundation to establish a scanning electron microscope facility.

The scanning electron microscope, perfected in the mid-1960s, enables effective study and illustration of structures that are below the level of optical examination. Its use is revolutionizing many fields of study by revealing unknown structures and suggesting new problems for investigation. Initial studies at Field Museum will be on such diverse subjects as habitat selection in bird and mammal mite parasites, pollen of Guatemalan plants, feeding in lamp shells, spore structure in fungi, shell formation in land snails, hair structure in bats, skin denticles in Paleozoic sharks, and illustration of minute beetles for major publications on classification.

A temporary exhibit on the potential of scanning electron microscopy is scheduled to open at Field Museum later this year.

John Bolt New Geology Assistant Curator

Dr. John Bolt recently joined the Department of Geology as Assistant Curator of Fossil Amphibians and Reptiles. Dr. Bolt received his doctorate from the University of Chicago in 1968 and came to Field Museum from the University of Illinois Medical Center, Department of Anatomy. His research is primarily on the evolution of early amphibians and reptiles and the changes in the composition of vertebrate communities of the Coal Ages.

History of Earth and Life Course

Dr. Matthew Nitecki, Associate Curator of Fossil Invertebrates, will teach an eight-week non-technical course on the History of Earth and Life at the University of Chicago Downtown Center beginning October 10. His lectures will discuss the following topics: description of the solar system; meteorites as a source of information about the origin and structure of the solar system; structure of the earth and theories of its origin; problems of the origin and nature of life; history of life and the fossil record of plants and animals; the major evolutionary events in the history of life; geology of the Chicago region; and conclusions about the nature of the physical and biological world.

This course is jointly sponsored by Field Museum's Department of Education and the University of Chicago Downtown Center.

Classes will meet from 7 to 9 p.m. on Tuesdays. Tuition is $45, and Members of Field Museum are entitled to a 10% discount. For further information, call Maria Matyas at FI 6-8300.

Illinois Endangered Species Protection Act Signed

Governor Richard B. Ogilvie came to Field Museum to sign the Illinois Endangered Species Protection Act August 7, in the presence of Museum Director E. Leland Webber plus many Museum staff members and an array of network TV cameras.

The new law will go into effect on January 1, 1973 making it illegal in the State of Illinois to possess, sell, offer for sale, give, or dispose of any animal, or product of such an animal, considered by the provisions of the law to be of an endangered species. Among the animals presently designated as endangered are wolves, tigers, leopards, alligators, crocodiles, and polar bears. The law provides for future revisions of the list.

New Women's Board President

Mrs. B. Edward Bensinger, who was recently elected president of the Women's Board of Field Museum, succeeding Mrs. Edward Byron Smith. Mrs. Bensinger also becomes a member of the Museum's Board of Trustees for the term of her office. With her is Edward F. Swift.

CHILDREN'S WORKSHOPS

This fall Field Museum's Department of Education is offering a ninth season of workshops for the children (and grandchildren) of Museum Members. These highly popular workshops have been devised to stimulate and develop interest in the natural sciences by providing children with an opportunity to meet Museum staff members and work with specimens and materials from the scientific collections. Workshop themes are geared to different age levels and interests, and each program lasts approximately one hour and fifteen minutes. All programs will be given twice, once at 9:30 a.m. and again at 11:00 a.m.

The number of participants for each workshop is limited so that each child can have a close working relationship with the staff. Reservations are necessary, and early registration is advised. Applications will be accepted in the order in which they are received. Each applicant is limited to one workshop only. It may be impossible to accommodate all applicants at this series, but more workshops will be offered later in the year; the dates and topics will be announced in a later issue of the *Bulletin*. Please send a separate application for each child in your family who wishes to participate. Accepted applicants will receive a confirmation card that will admit them to the workshop.

Eskimo Seal Hunt

Oct. 7: Edith Fleming, leader; ages 9-11

After viewing the film "Angote," which shows the life of an Eskimo boy from the time he is a baby until he is old enough to go on his first seal hunt, boys and girls see and handle real hunting equipment used by Eskimos: weapons, goggles to protect the eyes from sun glare, and clothing designed to keep out the Arctic cold. Then the children seek out the seal in its native habitat in Museum exhibits and learn more about the problems of the hunt.

Who's Who?—An Animal Guessing Game

Oct. 14: Julie Castrop, leader; ages 9-11

Can you identify an animal by examining only its tusks, its fur, its shell? This workshop gives children an opportunity to see and handle many such specimens, draw pictures of their animal owners, and participate in a guessing game with other children.

Picture Stories

Oct. 21: Harriet Smith, leader; ages 9-11

Children learn the importance of animals and of story-telling by studying the use of pictures in the lives of our western tribes, by viewing a film, and by examining decorated objects made by Plains Indians. Children have the opportunity to draw, using Indian symbols, either their own picture-story of a "happening" on a miniature tipi cover or their own dream of the future on a paper shield.

Bone Soup

Oct. 28: Martha Lussenhop, leader; ages 9-11

Participants "fish" for bones in a large pot, examine them, and group them with other bones belonging to the same animal. Children work together in arranging the bones of a skeleton according to their own ideas of the vertebrate plan. Comparable bones of different animals (including human) are used, and differences in structure are related to the different animals' food habits and modes of locomotion.

Microscopes—How Does It Look Up Close?

Nov. 4: Julie Castrop, leader; ages 11-13

Participants will have an opportunity to work with microscopes to gain an understanding of how this essential scientific tool works and how it is used. Living organisms will be observed "up close."

Fossils—"Antiques in Nature's Attic"

Nov. 11: Martha Lussenhop, leader; ages 9-11

What is a fossil? How is it formed? What can we learn by studying fossils? These are some of the questions that participants will try to answer. Following a demonstration of how fossils are formed, the children will make clay molds and plaster casts of small objects. Children will have the opportunity to examine fossil bones still encased in plaster jackets and in various stages of preparation.

African Drums and Masks

Nov. 18: Edith Fleming, leader; ages 11-13

Original African art and music are examined. Participants study African masks and then make their own designs with colorful material such as seeds and beads. After listening to Ghanaian drum music, participants learn to play African rhythms on African instruments.

Totems

Nov. 25: Harriet Smith, leader; ages 12-15

A film that illustrates the totemic art of the Northwest Coast Indians plus several actual examples of the art demonstrate the close relationship these people feel with certain animals prominent in their mythology. Each participant then explains why he chooses a specific animal as his totem and stylizes it into symbolic designs he paints on a storage box for himself.

Application for Fall Workshops

Program desired

_____ *1st choice*

_____ *2nd choice*

_____ *3rd choice*

_____ *4th choice*

Time (circle preference) 9:30 a.m. 11:00 a.m.

_____ *Name of child*

_____ *Address*

_____

_____ *Age of child*

_____ *Membership in name of*

Cut out and mail to: Raymond Foundation, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago Illinois 60605.

CALENDAR

Exhibits

Closes September 8

Chokwe Mask from Angola, on display in the South Lounge. One of the most beautiful of all Chokwe masks, it is called "Mwana Pwo," meaning young woman, and is worn by a male dancer at initiation and other important ceremonies.

Closes September 24

Australian Aboriginal Art: Arnhem Land, a selection of nearly 400 bark paintings and wooden ceremonial sculptures. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Hall 27.

Opens September 9

Shorebirds of North America, a collection of original illustrations by Robert Clem, on display in the South Lounge through November 5.

Continuing

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit exploring the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with the physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. Continues indefinitely.

Film and Tour Program

Guided Tour of Field Museum exhibit areas leaves from North Information booth at 2 p.m. "Through These Doors," a color motion picture focusing on behind-the-scene activities at the Museum shown at 3 p.m. in the Lecture Hall. September 1 only.

Weekend Motion Pictures at 1 and 3 p.m. Saturdays and Sundays in the second floor North Meeting Room:

September 2 and 3: **"The Mystery of Animal Behavior"**

September 9 and 10: **"Seals"**

September 16 and 17: **"Land of the Drowned River"**

September 23 and 24: **Private Life of the Kingfisher"**

September 30 and October 1: **"The Hidden World: A Study of Insects"**

Meetings

September 10: 2 p.m., Chicago Shell Club.

September 12: 7:30 p.m., Nature Camera Club of Chicago.

September 13: 7 p.m., Chicago Ornithological Society.

September 13: 7:30 p.m., Windy City Grotto, National Speleological Society.

September 14: 8 p.m., Chicago Mountaineering Club.

September 26: 7:30 p.m., Nature Camera Club of Chicago.

September Hours

9 a.m. to 9 p.m. Friday, Saturday, and Sunday, September 1, 2, and 3, and 9 a.m. to 6 p.m. Monday, September 4 (Labor Day). Remainder of month from 9 a.m. to 5 p.m. daily Saturday through Thursday, and 9 a.m. to 9 p.m. Friday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410

Children's Program

Begins September 1

Fall Journey for Children, "Archaeology in the Midwest," a free self-guided tour. Youngsters are provided with a questionnaire which routes them through Museum exhibit areas. It helps them to reconstruct the story of human happenings in the Midwest from the arrival of the first Indians until Europeans began recording the history of this area 300 years ago. All boys and girls who can read and write may participate in the program. Journey sheets are available at Museum entrances. Through November 30.

Coming in October

Fall Film Lecture Series, 2:30 p.m. Saturdays in James Simpson Theatre.

October 7: **"Britain's Holiday Islands,"** narrated by Robert Davis.

October 14: **"The Sea in your Future,"** narrated by Owen Lee.

October 21: **"Belgium and Luxembourg,"** narrated by Branislav Denitch.

October 28: **"Exotic Korea,"** narrated by Gene Wiancko.

Motion pictures of the Northwest Coast Indians will be presented Sundays in the second floor North Meeting Room. **"Legend of the Magic Knives"** is shown at 1 p.m. and **"The Loon's Necklace"** at 3 p.m.

Erratum: In the April issue of the *Bulletin,* page 2, beginning at the sixth line from the end, the sentence should read: On this basis the world could sustain a population of some 6 millions.

Volume 43, Number 9
October 1972

Field Museum of Natural History Bulletin

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Cover design derived from this time exposure of 1971 Cerro Negro volcanic eruption in Nicaragua

2 Scientific Hot Line
Edward J. Olsen
how the Center for Short-Lived Phenomena keeps scientists informed

6 New Neanderthals
Glen Cole
why contemporary ideas about what Neanderthal man looked like are different from earlier beliefs

8 The Cave of the Peking Man
Willis Barnstone
a poem

10 The Search for Peking Man
Christopher G. Janus
a chronology of events since June 1972

11 Onward and Upward with Geology
Eugene S. Richardson, Jr.
a second chapter in the history of the Geology Department

15 Capital Campaign
more Chicagoland business leaders who have joined Field Museum's $25,000,000 capital campaign

16 Letters

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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SCIENTIFIC HOT LINE

EDWARD J. OLSEN

Ecology, like the weather, generates a good deal of talk but painfully little action. One of the difficulties of course is that, like the weather, the problem is so massive it is difficult to tell where and what to attack first.

One of the many aspects of ecological problems—indeed, of the whole of our physical, anthropological, and biological environment—is the lack of a sufficient storehouse of data from which to draw so that attacks can be planned and goals outlined. True, we have been gathering data in an orderly, scientific sense about the world around us for several centuries. The physical, biological, and anthropological environments are known in general, and in some limited instances in great detail. However, not enough is known in detail sufficient to make confident predictions of the consequences of possible major courses of action designed to control undesirable conditions.

In the past a good deal of our information about phenomena in the environment around us was gathered not by scientists but by newspaper men. For examples: Volcanic eruptions, if large and destructive, were reported in newspapers, while small eruptions or ones which were large but occurred in isolated regions were ignored. The discovery of a small tribe of heretofore unknown primitive people in an isolated mountain valley in South America, say, was reported in detail in the Sunday supplements if they were headhunters or practiced human sacrifice. If, however, they raised squashes and minded their own business, they were not generally considered newsworthy, deserving only of perhaps a few words on the back pages. A plague of ants in a jungle in Central America was important provided that huge losses of crops occurred. Smaller plagues would generate little or no attention.

Photos: *top*, Robert Citron, director of Center for Short-Lived Phenomena; *left*, Mount Mayon volcanic eruption, Philippines; *right*, Tanzania armyworm outbreak.

In each of these examples even if the event were deemed newsworthy, it might still pass unreported if some political, military, or social outrage or scandal preempted the space in that day's papers. More significant, however, was the time lag between the occurrence of an event or new find and the newspaper report to the world. For many such items the time lag often depended on how a given editor decided to compose that day's editions. It might be left until the next edition or left out entirely, depending on the space available. Many an event would be only a memory before any professional scientist was aware it had occurred at all. Chances for immediate, on-the-scene examination and gathering of data were diminished in most cases.

Thus, for a long time first-hand knowledge of natural events has been fairly biased and statistically unsound. This state of affairs was the result of the fact that the most complex inter-continental communications and reporting networks consisted of newspapers and their correspondents.

1384

SMITHSONIAN INSTITUTION
CENTER FOR SHORT-LIVED PHENOMENA

QUARTERLY INDEX TO EVENT CARDS
1 JANUARY-31 MARCH 1972

CARD NO.	EVENT	REPORT NO.	ISSUE DATE
1338.	WEST FAYL OIL SPILL	N	5 JANUARY
1339.	QUARTERLY INDEX TO EVENT CARDS		10 JANUARY
1340.	LABAN ISLAND OIL SPILL	1	7 JANUARY
1341.	SOUFRIERE VOLCANIC ACTIVITY	5	11 JANUARY
1342.	IZU-OSIMA EARTHQUAKE SWARM	N	24 JANUARY
1343.	TAIWAN EARTHQUAKE	N	25 JANUARY
1344.	GERMANIA CHEMICAL POLLUTION	N	25 JANUARY
1345.	TORRES ISLAND EARTHQUAKE	N	28 JANUARY
1346.	TAIWAN EARTHQUAKE	1	1 FEBRUARY
1347.	VILLARRICA VOLCANIC ERUPTION	2	1 FEBRUARY
1348.	TAIWAN EARTHQUAKE	2	1 FEBRUARY
1349.	HOMESTEAD BIRD KILL	N	2 FEBRUARY
1350.	SOUFRIERE VOLCANIC ACTIVITY	4	3 FEBRUARY
1351.	OYSTER CREEK FISH KILL	N	7 FEBRUARY
1352.	TAIWAN EARTHQUAKE	3	7 FEBRUARY
1353.	E. FLA. COAST COMMON LOON MORT.	N	9 FEBRUARY
1354.	KILAUEA VOLCANIC ERUPTION-1972	N	14 FEBRUARY
1355.	FIRTH OF FORTH SEADUCK KILL	N	14 FEBRUARY
1356.	PACAYA VOLCANIC ERUPTION	N	17 FEBRUARY
1357.	MELBOURNE BEACHED WHALES	N	18 FEBRUARY
1358.	SOUFRIERE VOLCANIC ACTIVITY	7	23 FEBRUARY
1359.	SOUFRIERE VOLCANIC ACTIVITY	8	29 FEBRUARY
1360.	HACHIJO JIMA EARTHQUAKE	N	29 FEBRUARY
1361.	NYIRAGONGO VOLCANIC ERUPTION	N	2 MARCH
1362.	PUYENUE VOLCANIC ACTIVITY	N	2 MARCH
1363.	ERTA'ALE VOLCANIC ACTIVITY-1972	N	6 MARCH
1364.	SOUFRIERE VOLCANIC ACTIVITY	9	7 MARCH
1365.	GRAY FOX EPIZOOTIC CANINE DIST.	N	10 MARCH
1366.	SOUFRIERE VOLCANIC ACTIVITY	10	20 MARCH
1367.	SELICE LANDSLIDES	N	22 MARCH
1368.	F.L. HAYES OIL SPILL	N	22 MARCH
1369.	GRÍMSVOTN JÖKULHLAUT	N	27 MARCH
1370.	SOUFRIERE VOLCANIC ACTIVITY	11	28 MARCH
1371.	PUYENUE VOLCANIC ACTIVITY	1	28 MARCH

As a basis for news gathering it was highly efficient. As a basis for data accumulation on natural systems of our world it was generally unsatisfactory. It was certainly not the fault of the newspapers, for they certainly do not exist to act as scientific data-sorting centers.

What has been needed for a long time is a means of obtaining rapid, complete reports of natural events. We would like to know for example, if there is any periodic or sequential pattern to volcanic eruptions around the world. For this we need to know the occurrences in time and place of *all* eruptions of any magnitude—not just the few most destructive ones each year. Or, for another example, we need to know if plagues of ants are infrequent newsworthy disasters or if they actually occur every year to some degree or other.

For many years the scientific community has been chewing on the idea of an international clearing house for all such events, with a widespread network of resident correspondents with training or interests in the sciences to report any phenomenon deemed useful, however small. In 1968 such an operation came into being. Under the sponsorship of the Smithsonian Institution, the Center for Short-Lived Phenomena was started. Robert Citron, formerly a manager of several overseas satellite tracking stations, was made its director, with headquarters at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, just down the street and around the corner from Harvard University. In the almost four years it has been in operation it has chalked up an impressive record.

It works like this. In 150 countries around the world are located over 3,000 correspondents, all volunteers. If any natural phenomenon occurs that is different from the expected day-to-day process, the nearest correspondent reports it. In the United States, reporting

is done by phone usually; from overseas it is done by telegraphing SATELLITES NEW YORK. The event reported is evaluated at the Center by a team which judges whether it is truly a short-lived phenomenon (correspondents occasionally are carried away in their zeal and make poor choices of events to report). A notice is then written and run off on 3 x 5 cards by a high-speed printer and sent off airmail to the subscription mailing list within a few hours of the time of the event.

The subscribers represent a large range of interests and disciplines: astronomers, anthropologists, geologists, physicians, geophysicists, teachers, students, statisticians, government agencies, libraries, zoologists. Depending on the nature of each subscriber's activity, he may subscribe for immediate reports, weekly summary reports, or monthly summaries.

Subscribers may elect to receive reports in any or all of four major categories: (1) earth sciences, (2) astrophysical sciences, (3) archaeological/anthropological sciences, and (4) biological sciences. The results have been most gratifying. Every year between 150 and 250 reports are issued. Some examples follow.

Over the past several years three groups of primitive peoples have been discovered in isolated regions (in Surinam, Paraguay, and the Philippine Islands) and reported to professional anthropologists within days of the discoveries. This permitted small numbers of anthropologists to go in and make observations before excessive contacts with the civilized world would cause alterations in the primitive state and life patterns of these several peoples.

In August of 1970 a large lake (Lake Linda) located on the Lemon Creek glacial field near Juneau, Alaska

Photo courtesy of Panamin Research Center, Manila, Philippines.

EVENT	67-71	"TASADAY MANUBE" TRIBE DISCOVERY	12 JULY 1971	1253.

An account of the discovery of a tribe thought to have been cut off from the outside world for at least hundreds of years was compiled and reported by Manuel Elizalde, Jr. head of the Presidential Arm on National Minorities-PANAMIN--with the collaboration of Dr. Robert B. Fox, Chief anthropologist of the National Museum and Director of PANAMIN research.

Contact with the "Tasaday Manube" tribe, living in a rain forest about 3,000 feet up Tasaday Mt. of South Cotabato Province on Mindanao Island in the southern Philippines, was made by helicopter June 7-8 and June 16.

The Tasaday were described as having no knowledge of rice, corn, salt, sugar or pottery; no contact with the sea (their language has no word for the sea); speaking a unique tongue related to that of Manubo neighboring tribes. They were described as food gatherers and traoopers whose technology was still based on the use of stone tools. Fox described them as southern mongoloid with a cultural appearance basic to early peoples in the Philippines. The Tasadays' greatest fear appeared to be epidemic sickness. The tribesmen recalled a plague of smallpox they call fugu. The Tasadays drape palm leaves over tree limbs for shelters and weave floor matting. They live in informal family groups with no apparent leaders, making group decisions--usually concerning food gathering, in open discussions. People who die of old age or accidents are buried where they die. Sick people may be abandoned.

EVENT NOTIFICATION REPORT

TYPE OF EVENT	ANTHROPOLOGICAL
DATE OF OCCURRENCE	DATES OF CONTACT JUNE 7-8 & 16.
LOCATION OF EVENT	TASADAY MOUNTAIN SOUTH COTABATO PROVINCE, MINDANAO ISLAND, PHILIPPINES
REPORTING SOURCE	ASSOCIATED PRESS MANILA, PHILIPPINES
SOURCE CONTACT	MANUEL ELIZALDE, JR. HEAD OF THE PRESIDENTIAL ARM ON NATIONAL MINORITIES, PANAMIN, & DR. ROBERT B. FOX, CHIEF ANTHROPOLOGIST, NATIONAL MUSEUM & DIR.PANAMIN RESH, MANILA,PHIL.

SMITHSONIAN INSTITUTION
CENTER FOR SHORT LIVED PHENOMENA
60 Garden Street
CAMBRIDGE, MASSACHUSETTS 02138
UNITED STATES OF AMERICA
CABLE SATELLITES NEW YORK
TELEPHONE (617) 864-7911

began to drain. Within 54 hours it had completely disappeared. Because of the alert sent out by the local correspondent, a number of interested scientists were able to arrive at the scene and make a series of observations and measurements that could explain this strange event.

It was the Center that first sounded the alarm over the rapid population explosion of the so-called "crown of thorns" starfish and its increasing devastation of the Australian Barrier (coral) Reef.

Destructive invasions of caterpillars in East Africa have been only sporadically reported in past years. The reports of recent years to the Center have shown these invasions to be an annual event of greater or lesser magnitude, and only infrequently does the magnitude attain disastrous proportions. It is hoped that reports over the coming years to the Center's subscribers will reveal a pattern to the peak population years that will be useful in understanding the problem and controlling it in a reasonable, ecologically sound manner.

Every year these reports of short-lived phenomena continue, the more useful they will become. Meteorite falls, oil spills, sudden animal migrations, wildlife kills (sudden discovery of large numbers of dead birds or fish in one area), forest fires of major ecological significance, volcanic eruptions—all are phenomena which bear upon our natural environment and require instant study to learn their small but lasting effect upon the world on which we live. The cumulative effect of many small events can ultimately be of major significance in creating changes in our environment. Keeping track of these will continue to be the work of the Center for Short-Lived Phenomena.

Dr. Edward J. Olsen is Curator of Mineralogy, Department of Geology, Field Museum.

EVENT	42-72	TRANSANDEAN OIL PIPE LINE LEAK	12 JULY 1972	1412.

"At Biribiri, about 50Km from the Pacific Coast terminal at Balao (Esmeraldas Province, Ecuador), the Transandean pipe line developed a leak which was immediately followed by an explosion and fire. One person was killed and several others were injured.

"The oil flowed into the Vilche River, an affluent of the Esmeraldas River. The spill, first estimated at 50,000 barrels, will probably turn out to be much less as the damage was detected early. It was thus thought that the detrimental effects on the flora and fauna in the area would be limited. It was expected that the leak would be repaired in three to four days. The pipe line had been in operation for less than one week when the leak developed.

"The pipe line starts at Lago Agrio (Amazone) at 137M above sea level. Its total length is 503Km and its highest point in the eastern Andes is 4,063M above sea level. The terminal at Babalo is 900M above sea level. The storage tanks for 322,000 barrels are located approximately 5Km north of the town of Esmeraldas, capital of the province of the same name. 432Km of the pipe line is 26" in diameter and the remainder is 20" pipe. The pipeline has a maximum capacity of 500,000 barrels of oil daily."

EVENT NOTIFICATION REPORT

TYPE OF EVENT	BIOLOGICAL
DATE OF OCCURRENCE	30 JUNE 1972
LOCATION OF EVENT	BIRIBIRI
ECUADOR, S.A.	
REPORTING SOURCE	OLAF HOLM
GUAYAQUIL-ECUADOR, S.A.	
SOURCE CONTACT	OLAF HOLM
CASILLA 49-66, GUAYAQUIL-ECUADOR,	
SOUTH AMERICA	

This report is based on notifications received from the Center's correspondents and is disseminated for information purposes only. The Smithsonian Institution bears no responsibility for its accuracy.

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60 Garden Street
CAMBRIDGE, MASSACHUSETTS 02138
UNITED STATES OF AMERICA
CABLE: SATELLITES NEW YORK
TELEPHONE (617)-864-7911

1409a.

QUARTERLY INDEX TO EVENTS

5 JULY 1972

EVENT NO.	NAME	LOCATION	DATE OF EVENT
21-72	DEWDALE OIL SPILL	CROMARTY FIRTH, SCOTLAND	20 MARCH
22-72	JAHROM EARTHQUAKE	IRAN	10 APRIL
23-72	TASMANIAN COAST WAVE DAMAGE	TASMANIA, AUSTRALIA	25-26 MARCH
24-72	BRAMBERG FIREBALL	AUSTRIA	21 MARCH
25-72	BUEDINGEN FIREBALL	WEST GERMANY	21 MARCH
26-72	MARBURG FIREBALL	WEST GERMANY	22 MARCH
27-72	MT. SEMERU VOLCANIC ACTIVITY	INDONESIA	APRIL
28-72	CHINO FARM GOOSE DIE-OFF	MARYLAND, U.S.A.	11 MARCH
29-72	HUA-LIEN EARTHQUAKE	TAIWAN, CHINA	24 APRIL
30-72	MANILA EARTHQUAKE	PHILIPPINES	25 APRIL
31-72	TIEN CHEE OIL SPILL	MONTEVIDEO, URUGUAY	11 MAY
32-72	LUNAR METEORITE IMPACT	MOON	13 MAY
33-72	KURIL ISLANDS SUBMARINE VOL. ACTIVITY	KURIL ISLANDS, U.S.S.R.	29 APRIL
34-72	CHARLESTON NITRIC ACID RELEASE	ILLINOIS, U.S.A.	29 MAY
35-72	CANADIAN LYNX IMMINENT INVASION	MINNESOTA, U.S.A.	MAY
36-72	SANGIHE EARTHQUAKE	INDONESIA	11 JUNE
37-72	HONG KONG LANDSLIDES	HONK KONG, B.C.C.	18 JUNE
38-72	ALAID VOLCANIC ERUPTION	KURIL ISLANDS, U.S.S.R.	JUNE
39-72	BRITAIN GANNET & SHAG MORTALITY	BRITAIN	FEB-JUNE
40-72	QUEENSLAND MOUSE PLAGUE	AUSTRALIA	1972

NEW NEANDERTHALS

GLEN COLE

Comparison of the two photos on the opposite page shows that our ideas today about what Neanderthal man looked like are quite different from what was believed by anthropologists of an earlier day.

When the Neanderthal family diorama was installed in the Hall of Stone Age Man (Hall C) 40 years ago, it was generally supposed that Neanderthal man was a creature who walked with a shambling gait with head thrust forward and knees always at least somewhat bent. Few anthropologists today see any reason to regard Neanderthal man as a creature whose stance or gait differed in any significant way from that of presently living people, and the figures in the Hall C diorama have been updated accordingly.

Earlier notions concerning the posture of Neanderthal man were strongly influenced by a reconstruction made from a particular skeleton found in 1908 near the village of La Chapelle-aux-Saints in France. This is a relatively complete skeleton and the only one with an appreciable part of a vertebral column. Complete or fragmentary remnants of 21 vertebrae were recovered. Nevertheless, as observed by Straus and Cave, two investigators who re-examined the skeletal material in 1955, "the La Chapelle spine . . . does not constitute the most favorable material for an attempted assessment of healthy normal Neanderthal posture." It was found that this individual, a male, probably between 40 and 50 years old, was suffering from osteoarthritis which seriously deformed the spinal column, especially the cervical portion. Although the paleontologist Marcellin Boule, who reconstructed these fossil remains, recognized the arthritic condition, he discounted its deforming effect.

Further, the skeleton, although relatively complete, was quite fragmentary and a considerable amount of reconstruction was required. The intellectual climate of the time, conditioned by the then current state of evolutionary theory and the imperfect knowledge of the Quaternary time scale, seems to have oriented Boule to expect a brutish individual quite different from living forms of man, although still clearly *Homo*. With poorly preserved material, then, there was plenty of room for interpretation, and Boule seems to have let his expectations color his judgment. So, he was led to see, and reconstruct, many "simian" traits and archaic features which more recent investigators are inclined to regard as unduly emphasized or simply erroneous.

Certain characteristics of the femoral shaft and heads of the tibiae had been cited as evidence that Neanderthal man walked with a bent-kneed gait. However, similar characteristics of the femur and tibia are often found in modern populations and do not affect the standing or walking posture. A backward-bending tibia head, for example, is commonly met with amongst people much given to squatting, as are certain supplementary facets at the lower end of the bone (as Boule recognized). The presence of these characteristics in the La Chapelle-aux-Saints and other Neanderthal bones, rather than indicating archaic or "simian" characteristics, more likely indicates that the posture of the older man tending the fire in the Hall C diorama was a common one amongst the Neanderthal peoples.

In making the new figures, sculptor Joseph Krstolich worked from casts and measurements of various Neanderthal remains from western Europe. We did not attempt to reconstruct particular individuals from sites on Gibralter, the setting for the diorama. Remains of only two Neanderthals, one a child and the other an adult female, are known from this locality. Rather, we felt that persons resembling our new figures would not have been out of place in the Neanderthal populations of France and Spain of 50,000 years ago, at least insofar as general body conformation is concerned.

Of course, when such unpreserved aspects of Neanderthal man's appearance as clothing, skin color, and hair form, length, and style are concerned, much guesswork is involved and we could be far from the mark. We don't know, for example, that a Neanderthal female would have been apt to wear her hair long, or a male to wear his short, or even if either would have had any choice in the matter. It is not known just when in the history of human evolution people began to be capable of growing long hair. As no anthropological data could be brought to bear on the question, Mr. Krstolich's artistic sensibilities were allowed to hold sway and the new Neanderthal woman, as was true of her predecessor, has retained her long hair.

Dr. Glen Cole is Associate Curator of Prehistory, Department of Anthropology, Field Museum.

BEFORE . . .

Early interpretations of fossil remains of Neanderthal people led us to think they looked like this.

By around 100,000 years ago, *Homo sapiens* was distributed over much of the Old World; as far east as Java and China, and in the Middle East, Africa, and Europe. In Europe the type was Neanderthal man who inhabited the numerous caves and rock-shelters especially in France and Spain. By 25,000 years later the climate was becoming cold with the onset of the most recent glaciation and much of Europe became tundra and cold forest. Neanderthal man hunted wooly mammoth and rhinoceros, reindeer, and steppe-horse. Sheltering caves and fire were important for warmth.

Gibralter, the home of this family, was far enough south to be one of the milder areas of European Neanderthal's domain. These people, like their northern relatives, did hunt some of the large cold-weather animals but had, as well, shellfish from the Mediterranean for food.

Compared to his ancestor *Homo erectus*, Neanderthal man's progress is evident in his larger build, and in brain size now comparable to modern man's. Improved techniques in stone-working and the invention of a variety of tools show cultural advancement. Burial of the dead is also practiced for the first time in man's history, suggesting belief in an afterlife.

Approximately 35,000 years ago the Neanderthal population in Europe was replaced by completely modern Cro-Magnon men, who were probably descendants of Near Eastern Neanderthaloids. The replacement was complete whether due to competition, war, interbreeding, or other causes, and no Neanderthal remains are found after this time.

. . . AFTER

New reconstructions of Neanderthal figures, recently installed in Field Museum diorama, look much more like us.

THE CAVE OF THE PEKING MAN

soon after dawn a red dust is in the sky
and old men shadow box

or jog in shorts around the block. Shanghai* cabs
are driving on their horns

in the great Plaza of Heavenly Peace.
the masses in blue trousers

hurry to work. we go west by the silk route . . .
mirrors float on the paddies,

fields stink of human fertilizer, and hills
of green ink are fragrant

with wild herbs and mist . . . the ancient cave
is empty. we climb down

and rub our fingers futilely on the wall
where the cranium was stuck.

the Peking Man is gone. he may be in a
marine's footlocker or

at the bottom of the Pacific or in a
Japanese coffee shop.

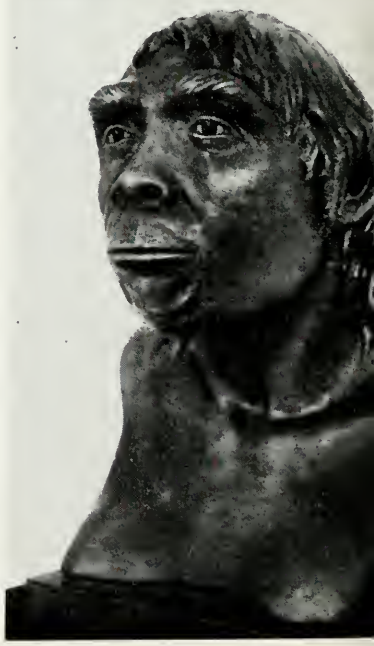
his forty comrades of the cave have also
split. they stopped breathing

about a half a million years ago . . . the masses
in blue trousers hurry to work

and dig up ancient coffins of an emperor
or greatly raise production

in a rubber shoe or paper factory. we have
been dying for a long time.

Willis Barnstone

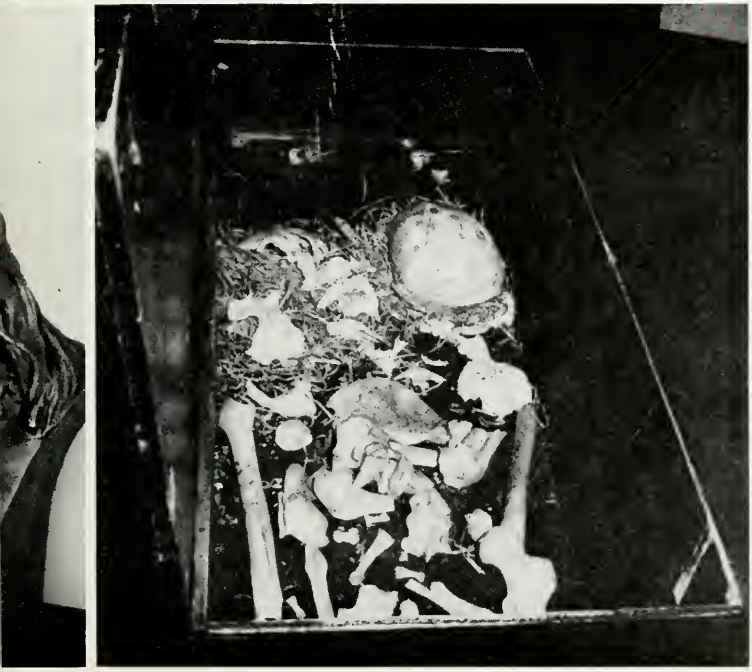


*"Shanghai" is the name of the automobile built in Shanghai.

Photos at left: cave at Choukoutien, near Peking, where first Peking Man fossils were found in 1926; reconstruction of Peking Man in museum at Choukoutien; taken in June 1972 by Willis Barnstone.

Dr. Barnstone is Professor of Comparative Literature, Indiana University. His recent book *The Poems of Mao Tse-tung* was a Book-of-the-Month Club alternate selection earlier this year.

Photo below: some of long-lost Peking Man fossils?



The missing Peking Man fossils are half-a-million-year-old remains from about forty individuals of a species of man now classified as Homo erectus *that were excavated from a cave near Peking beginning in 1926. In 1941 they were removed from the Peking Union Medical College for safekeeping, and went underground again December 8, 1941, the day after Pearl Harbor. They have been lost to the scientific world ever since.*

The whole story—as much as is known—was told by Dr. Harry Shapiro, Curator Emeritus of Physical Anthropology at the American Museum of Natural History, in the November 1971 issue of Natural History. *Apparently U.S. Marines who were interned as prisoners of war by the Japanese kept at least some of the fossils hidden from their captors for several years. Then those too disappeared.*

Last month—September 1 to be exact—the photo at left was brought to Field Museum and shown to Dr. Glen Cole, Associate Curator of Prehistory. He was asked, "Could these possibly be some of the fossils of Peking Man?" Thus another chapter of the story may have started to unfold.

It started this summer when five Americans on a cultural tour of China visited the Peking Man Museum at the site where the fossils were first found. Its director told them how important recovery of the fossils would be to the Chinese. The experience inspired the poem "The Cave of the Peking Man" by one member of the group. It inspired the leader of the tour, Christopher G. Janus, to set in motion events which led to his bringing the photo to Dr. Cole. Mr. Janus's chronology of those events is on the next page.—Editor.

THE SEARCH FOR PEKING MAN

Christopher G. Janus

The first real breakthrough in the more than 25-year search for the Peking Man fossils could be a photograph I received recently from a woman in New York who claims she has in her possession a footlocker left her by her late husband, a Marine, containing some of the fossils of Peking Man.

The black and white photo shows an open wooden footlocker containing what appear to be a nearly complete skull, part of another skull, a fragment of a pelvis, two distinct leg bones, and at least 20 other bone fragments.

The Greek Heritage Foundation offered a $5,000 reward in June to anyone in the world for information leading to the recovery and return of the Peking Man fossils to the Chinese. The photo and numerous other leads received since then are apparently in response to this reward offer. It all started when I and four other Foundation representatives made a 17-day visit to China.

This is the chronology of what has happened.

June 8, 1972. Visit to Peking Man Museum in Choukoutien, outside of Peking, where Wu Xing-chih, Museum Director, told us story of missing Peking Man fossils and how the Chinese regard them as among their most priceless historical treasures. He asked our help in finding them.

June 16. Arrived in Hong Kong, where at press conference I announced that the Greek Heritage Foundation offers $5,000 reward to anyone in the world giving information leading to return of Peking Man fossils to China.

June 19. Arrived Tokyo. Reward offer is repeated and story is carried on wire services.

June 27. Met with Dr. Harry Shapiro (Emeritus Chairman of Department of Anthropology, American Museum of Natural History) for lunch at Club 21, having learned about his interest in Peking Man fossils and his recent magazine article on them.

June 27. Received call at Harvard Club from woman who claims she has valuable information on Peking Man.

June 28. Met with Mr. Herman Davis, who with Dr. W. T. Foley was last known Marine to be with footlockers after Japanese capture. Davis gave me map he drew of Holcomb Prison Camp at Chinwangtao, where he last saw footlockers during World War II.

June 28. Met woman on 102nd floor Empire State Observatory, who showed me 5″ x 7″ picture of a footlocker allegedly containing Peking Man fossils. Won't reveal her name and scared off by photographer taking pictures at observatory.

July 17. Received letter from Colonel John White from San Francisco, who was one of Marines in China at time of capture. Offers to help in search for Peking Man so long as it does not conflict with book he is writing on subject.

August 1. Lunch with Dr. Shapiro at American Museum of Natural History to see his casts of Peking Man fossils. Invite him to come to China with us on October 14 to search for Peking Man.

August 2. Lunch with Dr. W. T. Foley, now a heart surgeon at Cornell Medical Center, who was entrusted with footlockers for transport to U.S. before captured by Japanese. Commends our search and suggests we somehow run story in China offering $5,000 reward for information on Peking Man. We invite him and Mr. Davis also to come to China with us October 14 as our guests to help in search for Peking Man in sites of former prison camps.

Wu Xing-chih, Director of Peking Man Museum in Choukoutien.

August 4. Ran front-page 2-line ad in *New York Times* asking "Empire State Observatory Woman" to phone me.

August 6. Received telephone call in Winnetka from "Empire State Woman" asking for a letter relieving her of all possible liability regarding her possession of Peking Man footlocker and asking for $500,000 for delivery of footlocker.

August 11. Received photo in mail—no return address or identification—of footlocker containing fossils. Picture is similar to one shown me by woman at Empire State Building.

August 12. Sent letter regarding $5,000 reward for information on Peking Man to 135 living Marines who were in Peking area at time Japanese captured them.

August 18. Sent representative of Greek Heritage Foundation to Dayton, Ohio to attend reunion August 19 and 20 of U.S. Marines captured in China at time of loss of Peking Man.

August 29. Sent copies of picture of fossils to Director of Peking Man Museum in Choukoutien and other officials in China, and also copies of picture to Dr. Shapiro and Dr. Foley for comment.

September 1. Took copy of picture to Field Museum of Natural History and showed to Dr. Glen Cole. He said if the skull is a fossil rather than a cast, it *could* be Peking Man—it is kind Peking Man had—very different from a modern skull. He also said some of the other bones are not human, and some that could be human weren't found at Choukoutien. He thought photo looks promising and urges pursuing the matter.

Christopher G. Janus is an investment banker with Bache & Co. and president of The Greek Heritage Foundation.

Chief Preparator Orville L. Gilpin and rockhound in the Bighorn Mountains of Wyoming, 1960.

Onward & upward with geology

Eugene S. Richardson, Jr.

In the first chapter of this chronicle of the Geology Department (see *Field Museum Bulletin*, May 1972) I mentioned that on Opening Day, June 2, 1894, the labels for all the Geology specimens were in india ink, penned by the Department's hard-working scribe. He wrote on slips of buff cardboard. Presently the Museum Press took over, and labels for added exhibits were printed—on the same small buff cards—in up-to-date DeVinne type. But by 1901 these labels looked a bit old-fashioned. Never willing to fall behind the times, the Museum shifted to an ingenious arrangement: small specimens were glued to heavy cards of dead black with the information printed (in DeVinne) in aluminum ink. The cards, of half a dozen modular sizes, could be laid out cheek-by-jowl in an endless pavement with no breathing space. Large specimens were accompanied by independent labels of the same black and silver design. The print shop set to work again. For 26 years they efficiently printed the modish new labels, two or three thousand of them each year. Farrington, Nichols, Riggs, Slocom, and finally Roy industriously kept the printers supplied with new or revised copy. By 1927 a trickle of 307 black labels came from the press and were placed among the exhibits. The job was done! A month or so later someone pointed out that black-and-silver labeling wasn't really consonant with the taste of the times.

Once more the curators set to work devising or revising copy, and the printers changed their ink. Over the next generation the black labels and cards were gradually replaced by good old buff, now reinstated, with the information printed in black in the old reliable DeVinne type.

When I first visited the Museum, during the Century of Progress Exposition in 1933, most of the fossil invertebrates

were still on black cards; when I returned in 1946, as Curator of Fossil Invertebrates, they were all on buff ones. Case after case displayed a mosaic of the modular cards, confronting the visitor with thousands of examples in every category. But by now there was something rather old-fashioned about this exhibition technique. Already plans were afoot to remedy the matter. Some of the Mineralogy and Economic Geology exhibits were already being redesigned by Harry Changnon, Assistant in the Department. Printed cards were abolished, the number of specimens was drastically reduced to give oomph to the exhibits, and labels were painstakingly made in the Geology Department itself, built up of individual letters pasted directly to the background of the exhibit cases.

In 1948 the Frederick J. V. Skiff Hall (Hall 37) was closed for reinstallation. Some of the specimens were brought upstairs to a large new storage room and others were placed temporarily in the blocked-off end of a neighboring exhibit hall. The displaced exhibits included Economic Geology from the east end of the hall—the displays that Dr. Nichols had personally installed in 1942—and fossil invertebrates and plants from the west end. Carpenters moved in and new exhibit cases, built immutably into the walls, arose.

For three years, while I picked out specimens and wrote label texts, Changnon's assistants, Henry Horback and (from 1950) Henry Taylor, laid out the labels, spray-painted the letters, gummed them in place, and mounted the specimens on concealed hangers. Color was coming to the Museum. Each of the 54 cases in Hall 37 had its own combination of background color and two colors of letters. Each case, with Changnon's proposed colors and layout, was personally approved by Mr. Stanley Field, President of the Museum, before the installation proceeded. The absence of pink, which we hadn't seriously considered anyhow, reflects Mr. Field's judgment.

One of the features of Hall 37 is the series of ten small habitat groups. A contract was made to have the restorations of extinct animals for these made by George Marchand, who had done similar reconstructions for some eastern museums. The actual installation of the models and the painting of the backgrounds was to be done by Art Rueckert, the same artist whom we last encountered in winter quarters in Labrador. But before Art had actually worked on the first of the groups, he dropped into my office to discuss the work and was abruptly felled by a fatal heart attack. The habitat groups were then completed by George Marchand on another contract.

Hall 37 was the first Museum exhibit hall to be entirely re-done in one operation after the war. The achievement had to be signalized. Invitations were sent out and on October 1, 1951, the new hall was opened for the first Members' Night in Museum history. Laboratories and offices, strangely tidy, were open for inspection; members also had a chance to see Bushman, freshly mounted and just receiving his finishing touches in the Zoology Department's taxidermy workroom.

More exhibits were updated. Harry Changnon, in charge of designing the new cases, now held the rank of Curator of Exhibits. He was studying geology at the University of Chicago and soon became the man to ask on matters of local geology. But until 1965, when he was transferred to the new Exhibition Department, the succession of new exhibits, eventually including almost every display in Geology, were all designed by him and executed under his supervision.

Hall 37 just before it was closed in 1948 for reinstallation. The dark mahogany cases were precisely spaced 12 feet apart.

Harry was not the only one on this staff destined to rise through the ranks. A teenager, Bryan Patterson, appeared in 1930 as "Assistant in Paleontology." In the same year Dr. Riggs returned from a season of collecting in Quinn Draw, Nebraska, bringing with him not only fossils but also Jim, one of the Quinn boys. Having left school early to work on the family ranch, Jim had managed to return later and complete the entire high school course in two years. While he worked with the paleontologists who came to the ranch he actually studied the fossils. Patterson, eventually our Curator of Fossil Mammals, left the Museum in 1955 for the Agassiz professorship that

he now holds at Harvard University. Quinn, who had become Chief Preparator in our fossil-fixery, left in 1946 to continue his formal studies and is now Professor and Chairman of the Department of Geology at the University of Arkansas. It was probably a good thing that Patterson and Quinn worked under the same roof; every observation that one of them made on a fossil was vigorously denied by the other. If wits are sharpened by friction, two universities can be grateful to the Museum for two sharp-witted professors.

Pat and Quinn were often in the field together starting with the 1931 season, when they tagged along as Riggs's assistants to Quinn's home territory in Nebraska. Collecting went on for five summer weeks, well beyond the budgeted time. In the Museum's annual report the Director acknowledged that "about one-third of the expense of the expedition was contributed by Messrs. Riggs and Patterson." It is almost a tradition in the Department to outlast field funds. It is certainly a tradition to extend a field trip (formerly called an "expedition") as long as possible.

Patterson's field trips developed something of an elaborate structure. Even before coming to the Museum Pat had collected butterflies and moths; a net was requisite for him. Sitting in his tent at night with a gasoline lamp while he wrote up his field notes, he was surrounded by a cloud of flying specimens drawn by the light. His typical field camp included a tent or two, a table or two, the butterfly net, a gasoline stove, and a trunkful of essentials, with particular emphasis on the pancake griddle. The only allowable pancakes in his camp were those prepared by Pat himself, mixed to a special formula and cooked with a special panache. If Sharat Roy was a perfectionist with curry, Bryan Patterson would admit no contest with pancakes. But even the curries could not remain unchallenged. Pat entered the field, and over the years his curries became ever more intricate. As, during the long simmering, he customarily annointed his taste-buds with strong potions, his curries attained a spiciness that readily separated the men from the boys. It is said that on later field trips he carried one suitcase for personal belongings and another (larger) for curry ingredients. On such heroic fare he worked long seasons in the field, with important results memorialized in the exhibits in Hall 38 and in many well acclaimed publications.

Sometimes serendipity is a feature of paleontological field work. We may name the discovery of "Triconodon Gully" as an example. Driving to the annual meetings of the Society of Vertebrate Paleontology in El Paso in 1949, Rainer Zangerl and Bob Denison had armed themselves with a hint from a Texas colleague about a spot where they might find some Early Cretaceous

Above: Chief Preparator Jim Quinn and part of a dinosaur leg bone found on a 1946 field trip to Texas. *Left:* Pancake expert Bryan Patterson on the same field trip.

turtles along the way. Just off the road in Montague County, Texas, they stopped and had a look. From among the scraps of turtle bone on the ground, Denison almost immediately picked up a fragment of a tiny jawbone. Small though it was, he recognized it as a mammal. Early Cretaceous mammals being then virtually unknown, he bore it off to El Paso in some excitement. The first order of business was to show the specimen to Patterson, who was already there. Shaking with excitement himself, Pat could hardly focus on the little thing, and made the occasion memorable by calling Room Service for a binocular microscope. Room Service couldn't supply one, but even without it, Pat shortly recognized the specimen as a piece of a triconodon, member of an extinct and little-known group of early mammals.

On the way back to Chicago the men stopped at the same place again, and once again Bob Denison picked up a partial triconodon jaw. That settled it. For the next two field seasons, Patterson was in Triconodon Gully—with Zangerl in 1950 and with Orville Gilpin (who had succeeded Quinn as Chief Preparator) in 1951. Besides the griddle and the butterfly net, the field equipment now included sturdy sieves and burlap bags. Since the specimens were small, and were widely scattered through a foot of sand, it was necessary to concentrate the proper sized particles, and this was done by washing the sand through a screen in a nearby cattle tank. While tons of sand and mud built up in the cattle tank, dozens of bags of concentrate were loaded for return to the Museum. Though Pat went off to Argentina in 1952 to make comparative studies of Riggs's earlier collections, Gilpin continued working at Triconodon Gully, assisted by Bill Turnbull, preparator (later to succeed Patterson in the chair of fossil mammals). A final six weeks in 1954, with Patterson and Gilpin together again, finished the triconodon field work. Eventually the concentrate yielded hundreds of little mammal fragments along with a greater number of fish, amphibian, and reptile bones.

The discovery of these early mammal remains depended on luck, certainly, but it depended also on Bob Denison's sharp eye for specimens. And the mere discovery would have been of little value without the long weeks of heavy labor in digging, washing, and concentrating the specimens and then picking out the mammal fragments individually back in the laboratory—which, in turn, would have been pointless without Patterson's subsequent study and the publication of his results. Thomas Edison's "nine-tenths perspiration" is a factor in paleontology, and so, sometimes, is luck—and so (importantly) are the study and the writing that put new knowledge on record.

At the end of that last field season there was another opportunity for luck to operate. On leaving Triconodon Gully, Pat and Gillie stopped for the last time at the General Delivery window of the Forestburg post office. A letter from the Director of the Museum was handed to them. It had been reported from Salt Lake City (wrote the Director) that a dinosaur might be collectible somewhere in Utah. The tip of a tail was just beginning to weather out and apparently could be followed into a hillside to expose the rest of the monster; please visit the locality on your way back and report on the feasibility of collecting the skeleton. The inevitable response from Forestburg was a wire requesting money—Messrs. Patterson and Gilpin had naturally come to the traditional end of their field funds.

Newly solvent, they set off for Salt Lake City to confirm the dinosaur report—but by way of the Rio Grande country, where there were some fossil-bearing rocks that ought to be looked at. At that far-off locality Pat strode over to a hill about half a mile from the truck and wasn't seen again for six or eight hot, parched hours. Either he had lost his way or Gillie had moved all the landmarks—the matter remains obscure.

The detour to the Rio Grande involved nearly 300 miles. Upon tracking down in Salt Lake City the source of the dinosaur report, they found that the first step was to backtrack another 300 miles, to Hanksville, Utah. There at last they met the local person who had reported the tail tip peeking out of the hillside. He led them to a suitably flat site where by sundown they had their camp set up. That night a dry wind arose, which soon was strong enough to propel grains the size of BB shot. All night, sand and gravel drummed on the canvas. Gilpin was up early, fighting his way to the outcrop with its bit of dinosaur bone. With the first vertebra that he uncovered, he knew the worst. That dinosaur wasn't going into the hillside; it had been coming out, and now all that was left of it were a few tail bones.

The bacon and pancakes that morning were rich with the airborne concentrate and quite unusable, but at least the stuff settled to the bottom of the coffee. On the way to Green River, where they met the highway back to Chicago, sand several times choked the cooling surface of the truck's radiator. They didn't get a dinosaur, but they did get a memorable wind.

Hot air, however, is not one of the Museum geologists' main preoccupations, even when it's in the field. We are concerned with field work, certainly—and the more the better. But even this is not really an end in itself: from the field come the specimens that build up the collections. And the collections are the basis for the study that leads to our real objective, the increase of knowledge of the earth and its ancient environments.

Dr. Eugene S. Richardson, Jr. is Curator of Fossil Invertebrates, Department of Geology, Field Museum.

more Chicagoland business leaders who have joined Field Museum's $25,000,000 capital campaign

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midwest regional sales manager, A. B. Dick Company

chairman of office equipment and supply group

Vernon D. Rogers
vice president, administration, Joseph T. Ryerson & Son, Inc.

chairman of iron and steel group

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chairman in construction industry section

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chairman of hotels and motels group

John J. Cardwell
managing director, Chicago office, McKinsey & Co., Inc.

chairman of management consultants group

photo by Fabian Bachrach

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vice president, refining and marketing, Union 76 Division-Eastern Region, Union Oil Company of California

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William J. Kennedy
vice president, market development, Illinois Tool Works

chairman of drugs group

To the editor:

I have been a reader of your fine *Bulletin* for many years. In fact, my father sends it to me since I have moved to Moorhead, Minnesota. However, I am somewhat concerned over an article and the pictures accompanying this article in your July-August of 1972 issue. The article I am referring to is "Endangered and Disappearing Animals" by Melvin A. Traylor. In the group of pictures directly opposite the article there is one showing two snowmobilers. I have read the article over and over trying to find why this picture was included with others showing poaching of alligators, air pollution, water pollution, atomic explosions, garbage, strychnine, whaling, etc. Since there was no mention of snowmobiles or snowmobiling in the text, I fail to see the connection of the picture with the title. That is, unless the author wants to imply that snowmobiling is an endangering factor when it comes to the preservation of animals. If this is indeed his purpose, I would like to see in writing why he feels that snowmobiles are a threat to animal life and to possibly explain where he obtained this information. I hope environmentalists, preservationists, ecologists, biologists, and sportsmen are not crying wolf before all the facts are examined. In fact, that is just about the way the wolf did become extinct.

W. Wayne Larson
Marine Products Manager, Arctco, Inc.
Fargo, North Dakota

Editor's reply:

The editors, not the author of the article referred to, chose the photos, including the one of two snowmobilers, and therefore assume responsibility for the implication that snowmobiles are a threat to animal life.

It is true that as yet not much research data about the specific effects of snowmobiling on animals have been accumulated—partly because of lack of funds allocated to such research. That fact is pointed out in *Proceedings of the 1971 Snowmobile and Off the Road Vehicle Research Symposium,* which is a report of a June 1971 conference held in East Lansing, Michigan, sponsored by Michigan State University and the U.S. Bureau of Outdoor Recreation. However, several recent research projects were reported on at that meeting. Here is a quotation from one: "Snow cover is considered to be important to the survival of many animals that live beneath it (subnivean) because of the protection it affords from stresses of direct exposure to severe winter climate and predation . . . The recent explosion in popularity of snowmobiles for winter recreation has raised questions about ecological effects because in addition to their noise and exhaust fumes, snowmobiles compact the snow. It is the last factor, mechanical compaction of snowfields, that can produce a stress upon subnivean organisms and thereby increase winter mortality rates." ("Snowmobile Use and Winter Mortality of Small Mammals" by Miss Julie A. Jarvinen and Dr. William D. Schmid, Department of Zoology, University of Minnesota.)

And, from another report entitled *Off Road Recreation Vehicles,* a U.S. Department of the Interior Task Force Study published November 1971: "Recent experimental work done in Minnesota has demonstrated through the compaction of snow from the use of vehicles that a severe temperature change occurred in the subsoils. Such temperature changes can cause a retardation in vegetative growth which may well be the answer to summertime chemical treatment of powerline rights-of-way. Although of benefit under power lines, similar compaction and retardation of vegetation is of concern to the Bureau of Sport Fisheries and Wildlife in its Waterfowl Production Areas in the North Central States. The dead and compacted vegetation is apparently much less attractive to nesting birds."

The two documents mentioned contain a wealth of information about research completed and in progress, individuals and agencies involved, and regulatory measures that could minimize harmful effects of snowmobiling. They are available in the Field Museum library.

To the editor:

Please cancel my membership. Too much evolutionary theory in your *Bulletin* and Museum. As a Christian I don't want my family exposed to such *rot.*

Ellsworth K. Ewert
Cicero, Illinois

To the editor:

Congratulations to Bronson for his ringing piece ["The Campaign Against the Antiquities Trade," *Field Museum Bulletin,* September 1972], and to the museum for its concurrent announcement of the new policy. Please convey my admiration to Bronson, and you might tell him, in view of his special interest, that the Jimbal stela is now lying behind the Tikal museum.

Clemency Coggins
Auburndale, Massachusetts

To the editor:

We were delighted to receive your strict acquisition statement regarding antiquities of unknown origin. This subject has been one of great concern for ICOM, and we have been working for some time to encourage museums to adopt this kind of acquisition policy. As so many museums seem impervious to this line of thought, it is encouraging to see others taking an ethical stand despite the trends and rationalizations offered by the profession at large. Congratulations!

Bonnie Burnham
Project coordinator, Ethics of acquisition
The International Council of Museums
Paris, France

To the editor:

Just a note to tell you how much we appreciate the *Field Museum of Natural History Bulletin.* The articles are very interesting and easily readable for the layman. The first thing we turn to is "Calendar" because it gives such convenient and detailed information, particularly about programs for children. We have found the year's calendar in the January issue particularly useful, not just for Museum events but also for entering our own events in the daily squares. We look forward to future issues.

Mrs. Patt Murray
Chicago, Illinois

Please address all letters to the editor to

Bulletin
Field Museum of Natural History
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

The editors reserve the right to edit letters for length.

CALENDAR

Exhibits

Continuing

Shorebirds of North America, a collection of original illustrations by Robert Clem, on display in the South Lounge through November 5.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit explaining the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through March 25. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with the physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. Continues indefinitely.

Children's Program

Continuing

Fall Journey for Children, "Archaeology in the Midwest," a free self-guided tour. Youngsters are provided with a questionnaire which routes them through Museum exhibit areas. It helps them to reconstruct the story of human happenings in the Midwest from the arrival of the first Indians until Europeans began recording the history of this area 300 years ago. All boys and girls who can read and write may participate in the program. Journey sheets are available at Museum entrances. Through November 30.

Film and Tour Program

Fall Film Lecture Series, 2:30 p.m. Saturdays in James Simpson Theatre.

October 7: **"Britain's Holiday Islands,"** narrated by Robert Davis.

October 14: **"The Sea in Your Future,"** narrated by Owen Lee.

October 21: **"Belgium and Luxembourg,"** narrated by Branislav Denitch.

October 28: **"Exotic Korea,"** narrated by Gene Wiancko.

Motion pictures presented at 1 and 3 p.m. Saturdays and Sundays in the second floor North Meeting Room:

Sunday, October 1, only: **"The Hidden World: A Study of Insects."**

Following weekends: Two films on the Indians of the Northwest Coast, **"Legend of the Magic Knives"** and **"The Loon's Necklace,"** included in each program.

Meetings

October 10: 7:30 p.m., Nature Camera Club of Chicago.

October 11: 7 p.m., Chicago Ornithological Society.

October 11: 7:30 p.m., Windy City Grotto, National Speleological Society.

October 12: 8 p.m., Chicago Mountaineering Club.

October 24: 7:30 p.m., Nature Camera Club of Chicago.

October Hours

9 a.m. to 5 p.m. Saturday through Thursday, and 9 a.m. to 9 p.m. Friday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410

Live Demonstration

October 7

Lamidi Fakeye of Nigeria, Africa, will give a wood carving demonstration at 10:30 a.m. Saturday, October 7 at Field Museum. Inquire at information booth for specific location of event. The sculptor, who works in the traditional manner, is of Yoruba ancestry and is descended from several generations of wood carvers.

Traditional carvings done by four contemporary Nigerian carvers. Carving at left is by Lamidi Fakeye, who will be at Field Museum October 7.

Coming in November

Opens November 11

Greenland: Arctic Denmark, a major special exhibition covering all aspects of the history and culture of the world's largest island. The extensive collection of archaeological and ethnological material is supplemented by photographs and audio-visual material to illustrate various areas of economic development and social change in modern Greenland. The exhibition is sponsored by the Embassy of Denmark and is shown under the auspices of the Smithsonian Institution Traveling Exhibition Service. Through March 8. Hall 27.

Fall Film Lecture Series, 2:30 p.m. Saturdays in James Simpson Theatre.

November 4: **"Sweden,"** narrated by Dick Reddy.

November 11: **"Hawaii,"** narrated by Norman Schley.

November 18: **"Saga of the Inca Empire,"** narrated by Geza De Rosner.

November 25: **"The Little Things in Life,"** narrated by Fran William Hall.

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November 1972

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Cover: Chicomecóatl, Aztec goddess of corn and the fertility of the earth; 15th century specimen from Texcoco, Valley of Mexico; in Hall 8, Field Museum.

2 The Mystery of Maize
George W. Beadle
a Nobel-prize-winning geneticist explains why he is convinced that teosinte is the wild ancestor of corn

12 The Two Revolutions
Bennet Bronson and William Burger
the Agricultural Revolution that began 10,000 years ago increased the quantity of life; the Green Revolution happening today is enhancing the quality of life

15 Field Briefs

16 Capital Campaign

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Elizabeth Munger; Editorial Assistant Vicki Wilson; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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the mystery of maize

george w. beadle

Passersby on Ellis Avenue near 55th Street are likely to wonder what a half-acre of corn is doing on the University of Chicago campus, so close to the heart of the city. If I happen to be working there, which is often during the summer months, some will stop to ask. Depending on the pressure of work, my answer may be brief: "It is a part of a study of the origin of corn involving plantings also at the University of Illinois, Urbana, and Mexico City." Or, if interest persists and time permits, I may explain that I worked on the origin of corn forty years ago as a graduate student and thought then that I knew the answer. But in the intervening years several other biologists have published different theories, and textbooks and encyclopedias continue to present confusing and, I think, inaccurate accounts. Therefore on retirement from academic administration I elected to have a try at enlightening.

Corn and the origin of agriculture

Why is the problem significant? For one thing, corn, or maize, is now the world's third most important grain crop—more than 200,000,000 tons are produced per year. That is only slightly less than wheat and rice. It is the only major crop plant about which there is so much uncertainty and disagreement as to its genealogy.

Given an encouraging display of interest, I may go on at some length, beginning with some thoughts on the importance of agriculture in general to man's remarkable achievements.

Depending on how one defines man, he has been around for a good long time. The earliest known primate with man-like traits evolved some ten million or more years ago and lived in India and Africa.

Geneticist Dr. George Beadle in his Ellis Avenue "cornpatch" holding an ear of corn and a distinctly teosinte-like hybrid grown there as part of his research on the wild ancestor of corn. Photo by Ed Jarecki.

Archaeological evidence suggests that it took our line of descent seven or eight million more years to reach the stage of making and using the first primitive stone tools.

An estimated two million more years passed before our forebears regularly used and preserved fire for warmth, food preparation, and protection. That was some forty thousand years ago.

It was only about ten thousand years ago that some of our more enterprising ancestors discovered that they could plant, grow, and harvest food plants. Seemingly this discovery was made independently in the Middle East, the Far East, and in Middle America.

These evolutionary developments would therefore indicate that for 99.5 per cent of the time man has been making and using tools he had no significant agriculture—no domestic animals, no cultivated food crops. With agriculture, the cultural evolution that so clearly distinguishes our species from all others took a great leap forward.

It seems a reasonable estimate that prior to agriculture each person had, on the average, to exploit the resources of about seven square miles of land area for his food, clothing, and shelter. The earth has a total of some fifty-eight million square miles of land. Therefore the maximum possible population would have been about eight million people—not uniformly distributed, of course. But I doubt if the human population ever reached more than half that.

Thus, where ten thousand years ago there was one person, there are now a thousand or more. Where most able-bodied persons then had to be food gatherers, now in the United States only about one person in thirty is directly engaged in primary food production. The remaining twenty-nine-thirtieths of our population are freed for other activities.

Up to ten thousand years ago, there were no large cities, mostly campsites that were moved from one food source to another for gathering edible wild plants and hunting wild animals.

There was relatively little technology, not much more than fire plus stone, bone, and wood tools. Except in limited areas where edible wild plants and animals were abundant, there could be little more—most human time and energy had to be devoted to mere subsistence.

By the time of Columbus all the major crop plants we know today were being cultivated, and they were essentially as fully developed as they are today. Modern plant breeders have indeed multiplied the number of varieties, greatly increased the yields and quality, and selected and bred insect- and disease-resistant varieties. But I know of no major new cultivated food plants that have been developed in the last thousand years.

The discovery of corn

When Columbus arrived in the New World his men found on the island of Cuba great fields of a strange crop plant unknown to the eastern hemisphere. That was corn, or maize. Both names can be confusing, for in Europe the term "corn" refers to grains in general, while the name "maize" can be confused with the sorghum called milo maize, from Africa. Later, Linnaeus gave what we call corn the taxonomic name *Zea mays*, the genus *Zea* from Greek and the species *mays* from the Taino language of the West Indies. In this account I shall refer to it as corn.

Columbus had no way of knowing how tremendously important corn had been to the population growth and cultural evolution of the peoples of the new land. Only later was it found that corn, beans, potatoes, sweet potatoes, cucurbits, peanuts, tomatoes, cacao, and the other New World plants had played such essential roles in the

Toltec-Aztec religious, art, and trade center of Teotihuacán in the Valley of Mexico, site of the great Pyramids of the Sun and the Moon; of Dzibilchaltun in the land of the Maya; and of Chan Chan in Peru, built by the Chimu and conquered by the Inca. These places were all thriving cultural centers almost a thousand years before Columbus, with elaborate religions, arts, industries, and trading arrangements. Each is estimated to have had a peak population of from seventy-five thousand to two hundred thousand. They were major cities of their time—some of the largest in the world. They could not have existed without great quantities of foodstuffs which could be transported easily, and some of it dried and stored for long periods of time. Corn was the most important of these.

Corn kept the Pilgrims from starving during their first terrible winter in the new land. Governor Bradford wrote, "And sure it was God's providence that we found this corne for else we know not how we should have done."

Even with corn, half the members of that new colony died the first year. Without it, probably the others would have suffered the same fate. Had this happened, the estimated fifteen million descendants of the Mayflower Pilgrims wouldn't be with us today.

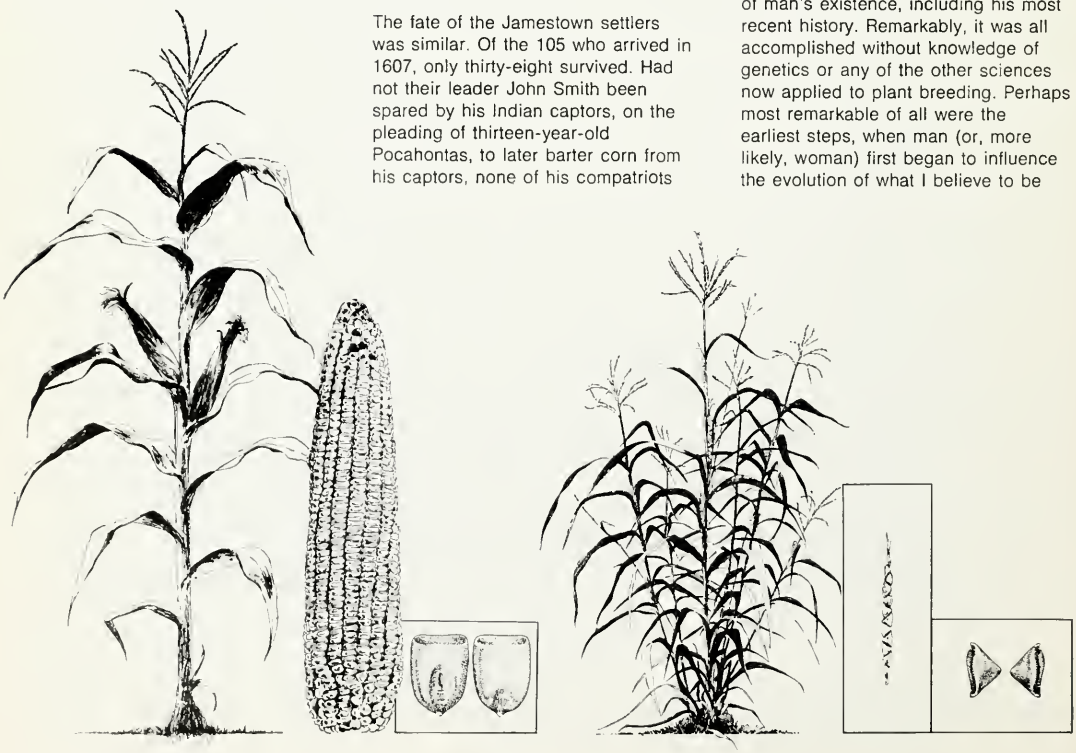
The fate of the Jamestown settlers was similar. Of the 105 who arrived in 1607, only thirty-eight survived. Had not their leader John Smith been spared by his Indian captors, on the pleading of thirteen-year-old Pocahontas, to later barter corn from his captors, none of his compatriots would have survived—in which case there would not be ten or so million descendants of the Jamestown colony living today.

If these estimates are correct, and I judge them to be conservative, they mean that something like one out of ten of us in this favored nation would not have been born—had it not been for corn.

How did corn happen?

Neither could Columbus have known that the American Indians had already developed two or three hundred races of corn, essentially all we have today. Theirs was the most extraordinary achievement in plant breeding in all of man's existence, including his most recent history. Remarkably, it was all accomplished without knowledge of genetics or any of the other sciences now applied to plant breeding. Perhaps most remarkable of all were the earliest steps, when man (or, more likely, woman) first began to influence the evolution of what I believe to be

Sizes of a modern hybrid corn plant, an ear of corn, and two kernels at left compared, respectively, to sizes of a teosinte plant, a teosinte "spike," and two teosinte fruits or "seeds."



the wild ancestor of corn. (It seems probable that women were the first agriculturists—that they first cultivated food plants and selected the more valuable types—while the men were off hunting, fishing, warring, gaming, and perhaps carousing a bit.)

For most cultivated plants, wild relatives are known from which they could reasonably have been derived. In fact, if one lists a dozen of the world's most important food crops—corn, potatoes, sweet potatoes, beans, and peanuts, all of New World origin, and wheat, rice, sugar cane, sugar beets, barley, sorghum, and soybeans, of the Old World—we find that for all except corn there are so many closely related wild species it is difficult to determine just which one or more were ancestral to a given present-day crop plant.

In the case of corn, early plant explorers had great difficulty finding any wild relative that could conceivably have been its ancestor. Even today no closely related grass is known with a female inflorescence like that of an ear of modern corn. The reason is obvious: corn is a man-made monstrosity, biologically speaking. It could not survive in the wild without his help because it has no satisfactory way of dispersing its seeds. Any wild plant that depends on seeds for survival must be able to do that. If an ear of corn is left to its fate in nature, it will, under conditions favorable for germination, give rise to a group of seedlings so densely clustered that none is likely to survive. Thus all known living corn is dependent on man for survival.

Finally, however, early plant explorers found what looked as if it might be a relative. It was a plant that grows in parts of Mexico, Guatemala, and Honduras, which natives in parts of Mexico called *teocentli,* from Nahuatl, the Aztec language, meaning "support of the gods." This is now anglicized to "teosinte." Taxonomists assigned it to the new genus *Euchlaena* and gave it the species name *mexicana.*

In 1780 teosinte was described by a botanist as a plant that ". . . looks like maize but its seed is triangular." Teosinte "seeds" (technically, fruits) are arranged in a single row of six to ten to form a somewhat flattened "spike" a few inches long and a quarter-inch wide. This is teosinte's counterpart of an ear of corn. Each individual kernel is completely enclosed by a dark, hard, shell-like fruitcase or jacket. The fruitcases develop as cup-like segments from the rachis (spine) of the spike. Cell layers that develop between the fruitcases cause the rachis to shatter at maturity, thus scattering the segments, hence the "seeds."

Teosinte plants tend to be more highly tillered than most cultivated corn varieties—that is, they have more stalks growing from the base of the plant—and each tiller, or stalk, produces female inflorescences—the spikes, or ear-equivalents—at many nodes. Teosinte tassels—the male inflorescences—are very much like those of corn.

Is teosinte the ancestor of corn? A few botanists thought so. Vinson, for example, wrote in 1877, "Following the thinking of Darwin, teosinte is the ancestor of maize." But most of his contemporaries disagreed. The female inflorescences, the "ears," were so different they could not believe the one could have been transformed into the other.

Later what seemed a more likely candidate was found, a plant intermediate between teosinte and corn. Because of its small ear with pointed kernels that resemble dogs' teeth and were partially exposed from individual jackets, it was called *Zea canina,* dog corn or coyote corn. But this was soon found to be a naturally occurring hybrid between teosinte and corn, a hybrid that is easily man-made and which is quite fertile. The fertility of this hybrid indicated that the genetic relation between teosinte and corn was much closer than was previously assumed.

Teosinte as the ancestor of corn

That was pretty much the situation when I began graduate work at Cornell in 1927 with the late R. A. Emerson. He had shortly before demonstrated that teosinte is a so-called short-day plant. It wants no more than about twelve hours of sunlight a day, combined with a warm temperature, and hence grows wild only where these conditions exist naturally. Emerson could induce teosinte to mature at the Cornell latitude by artificially shortening the summer day. As a part-time graduate student assistant, I was assigned to study the cytology and genetics of corn-teosinte hybrids. We confirmed the fertility of the hybrids and showed that the ten chromosomes of Mexican teosintes were highly compatible with the ten chromosomes of corn. They pair normally during formation of sex cells in the hybrids. We also showed that in the nine chromosomes which we could mark, the pairs exchanged segments in the hybrids essentially the same as in pure corn.

Our conclusion, perhaps not stated in so many words, was that cytologically and genetically corn and the Mexican teosintes can reasonably be regarded as one species. Therefore the hypothesis that the wild teosinte was the direct ancestor of cultivated corn was entirely plausible to us. We regarded the problem as essentially solved, believing that a relatively few major gene changes could and probably did convert the wild plant into a more useful cultivated one.

I well remember discussions with Emerson in which he pointed out that just two mutations could make teosinte an easily usable food plant—one to a non-shattering rachis, so the fruits will not be scattered and lost as food; the other to a soft fruitcase, so the kernels can be threshed free of them. I should add that these postulated mutations are much the same as known mutations that have played such significant roles in the evolution of cultivated wheat, rye, barley, and oats from their wild ancestors.

Experimental plantings of teosinte and hybrids in the University of Chicago greenhouse. Teosinte can be grown at this latitude only if amount of sunlight is regulated. Plants here are wheeled into a dark shed in early afternoon and brought out again in the morning.

To jump ahead now forty years, shortly before my retirement from academic administration I received a copy of Garrison Wilkes's 1966 monograph *Teosinte, the Closest Relative of Maize.* It is by far the best and most useful document on the subject I know. I read it with great interest and admiration, qualified by a deeply felt reservation on noting in one passage his characterization of the maize-from-teosinte hypothesis as a "crude" attempt to explain the origin of corn, and in another as the "myth" that teosinte is corn's ancestor. In retrospect I realized I over-reacted to those terms because of not appreciating the full context in which they were used. Through correspondence we argued the matter of corn's origin without coming to any agreement. I was, however, stimulated enough to decide that on retirement I would return to a study of the relation of teosinte to corn.

I should add, before elaborating, that Wilkes and I have remained good friends and have collaborated in two teosinte collecting trips in Mexico. I believe I have influenced his thinking to some degree. I know he has mine, though I remain firm in my belief that teosinte is the true and only wild corn.

How did I propose to study further the relation of the two? I decided to grow large-scale populations of second-generation and backcross populations of corn-teosinte hybrids—larger than anyone had grown before, in order better to estimate the magnitude of the genetic difference between them. The first cross was between Chapalote corn, a primitive variety and the most teosinte-like that was clearly corn, and Chalco teosinte, the most corn-like teosinte that was unmistakably teosinte. These choices were made to reduce the differences to those that are essential.

Mendel's laws say that if original parents differ from each other by only one gene, in the second generation of descendants each original parental type will reappear with a statistical frequency of one in four. With a difference of two genes, the frequency with which each parental type will be reproduced is one in sixteen; and so on for more genes. For ten gene differences, the reappearance of original parental types will be somewhat less than one in a million.

And for twenty differences, the reappearance of a particular parental type will be less than one in a trillion plants—which just happens to be about the total number of corn plants grown per year in the entire world. Thus if teosinte and corn differed by a large number of genes, even as few as ten or a dozen, I could not grow and examine hybrid populations large enough to produce good offspring equivalent to the original corn and teosinte parents. They would be so rare as to be unrecoverable in any population that could reasonably be grown and classified.

I resolved to grow up to 50,000 second-generation plants, if necessary. This would give a reasonable chance of finding types like the two different parents—corn and teosinte—if there were no more than six or seven major gene differences involved. With this year's plantings, I estimate that we will have grown and examined just about that many—50,000.

Since teosinte will not mature at U.S. corn-belt latitudes—because, as mentioned, it is a short-day plant—there was a problem of where to grow the hybrid populations. I was fortunate in being able to make arrangements with Dr. Edwin J. Wellhausen to grow them at the International Maize and Wheat Improvement Center's El Batán station near Texcoco, Mexico. I have been additionally privileged in having as a collaborator there Dr. Mario Gutiérrez, who is now looking after our fourth planting. Professor Walton Galinat of the University of Massachusetts collaborated in the

Dr. Beadle examines a primitive type of corn he has derived from a cross between teosinte and corn.

classification of the first large second-generation crop grown in Mexico.

What have been the results? In the second-generation cross of Chapalote corn and Chalco teosinte we found good parent corn types and good parent teosinte types with a frequency of about 1 of each in 500 plants. These frequencies are intermediate between those expected with four and those expected with five gene differences. Of course, the genetic complexities are greater than this kind of arithmetic implies, but I will not go into them here. Second-generation and backcross populations have been grown involving other races of both corn and teosinte. They show that the frequencies with which the parental corn and teosinte reappear may vary rather widely depending on the races involved.

In response to doubts about whether the recovered corn ears were really "good" parental type corn expressed by Professor Paul C. Mangelsdorf, who has published very different ideas about the origin of corn, I devised a "cob quiz." Cobs from "pure" parent corn and cobs from my hybrid populations were coded and presented separately to Professor Mangelsdorf and also to Professor Galinat for classification. Both of them judged enough cobs of hybrids to be those of good corn to reassure me, and I hope convince them, that "good" parental type corn is indeed recovered in reasonable frequencies in second-generation hybrids and in backcrosses of first-generation hybrids to corn.

It seems clear that the genetic differences between corn and teosinte cannot be so great as to render untenable the hypothesis of an ancestral relationship of teosinte to corn. And it seems reasonable to assume that pre-Columbian man could have selected and preserved the relatively few mutants required to produce a useful plant from teosinte—primitive corn.

Contradictory theories

One of the principal skeptics of this theory is Professor Mangelsdorf, formerly at Texas A. & M., then at Harvard, and now at the University of North Carolina. In 1938 he and a colleague, R. G. Reeves, proposed that teosinte was not ancestral to anything, but instead was a relatively recent species resulting from hybridization of corn and a species of the genus *Tripsacum*. This hybrid does not occur naturally but can be man-made by special techniques. Their principal argument was that teosinte is intermediate between *Tripsacum* and corn in many morphological traits.

I never believed this hypothesis and said so in 1939. My reasons were: First, corn and *Tripsacum* have never been known to hybridize naturally, despite the fact that they grow in close proximity over millions of acres. Second, none of the eighteen chromosomes of *Tripsacum* pairs normally with any one of the ten corn chromosomes. Third, the man-made corn-*Tripsacum* hybrids are completely male sterile.

Nevertheless, this *Tripsacum* hypothesis has for a third of a century been supported by its proposers, with the result that it has thoroughly permeated genetic, botanical, plant breeding, anthropological, and other literature, often being transformed from an hypothesis to an established fact. It is repeated in encylopedias, in compendia, and in many textbooks.

Recently Professor Galinat has shown that the fruitcase of teosinte, which the *Tripsacum* hypothesis must assume to have been contributed from *Tripsacum* as a block of closely linked genes, could not have arisen in that way for the simple reason that no such group of genes can be demonstrated in *Tripsacum*. In contrast to teosinte, the *Tripsacum* fruitcase appears to be governed by genes that are not closely linked.

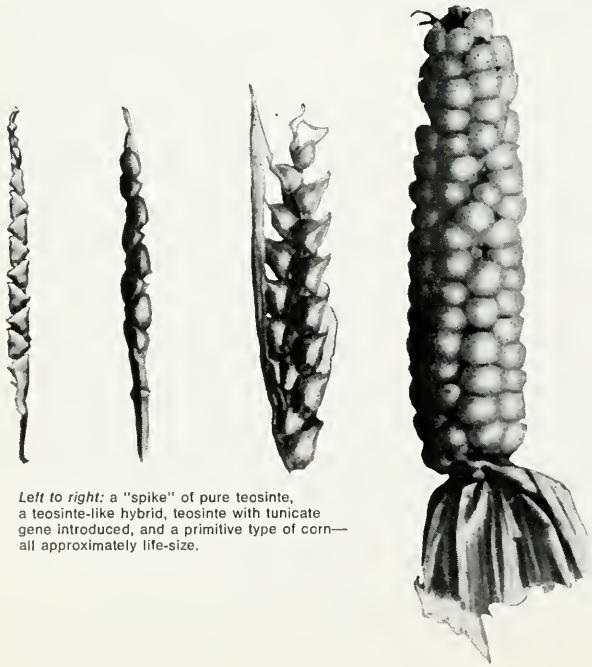
At a recent conference at Harvard Professor Mangelsdorf conceded that

the evidence against the *Tripsacum* hypothesis was substantial. He now proposes an alternate hypothesis, to be presented in his forthcoming book on corn and its relatives, which he has kindly permitted me to see in manuscript form.

His new proposal assumes that the oldest corn found in archaeological sites was wild and was the ancestor of modern corn. Further, he believes that wild corn antedated the teosintes, which he now proposes were derived from this wild corn by mutation. This is indeed a dramatic reversal, for prior to this new view he maintained that teosinte and corn were so different that teosinte could not have been ancestral to corn. If corn could have given rise to teosinte, the reverse must also be possible—and I would say much more probable, for teosinte is a highly successful wild plant and corn is not.

These earliest archaeological specimens which Professor Mangelsdorf postulates as wild corn he assumes to have dispersed their seeds in part by virtue of a fragile cob. There seems to be a curious inconsistency in this view.

If these earliest archaeological specimens were wild corn and had brittle cobs, how could they have survived harvesting, transportation to the caves where they were found, shelling of the kernels, mixing with other debris on the cave floors, plus being tramped on before being covered with the protecting layers of soil that preserved them to become archaeological specimens? If the cobs were indeed brittle, this would indicate teosinte ancestry. If they were not brittle, I fail to see how they could possibly have been wild corn, for how then would they have disseminated their seeds?



Left to right: a "spike" of pure teosinte, a teosinte-like hybrid, teosinte with tunicate gene introduced, and a primitive type of corn—all approximately life-size.

The archaeological evidence

What is the archaeological evidence? Beginning in the 1940s many dry caves in the U.S. Southwest and in Mexico have been explored by experienced archaeologists. Among the many recovered materials that reveal much about the lives of the peoples who occupied these sites are remains of corn, including cobs. Radioactive-carbon dating has shown that the oldest cobs so far found were grown something like 7,000 years ago.

The cobs tell us a great deal about the evolution of cultivated corn over the past seven millennia because sequences of cobs have been found in some caves that clearly indicate changes under domestication.

The oldest cobs are very small, just an inch long, more or less. Mangelsdorf, MacNeish, and Galinat, who have studied a great many of them in detail, estimate that each of them bore about fifty to sixty small kernels. Mangelsdorf's interpretation of these cobs as the remains of a truly wild corn rests mainly on their reported uniformity plus the fact that they occur at earlier levels

Distribution of teosinte compared with that of corn: teosinte grows wild only in Mexico, Guatemala, and Honduras; corn has spread throughout most of North and South America.

than other plant remains unmistakably known to have been cultivated.

If there had been such a wild corn growing independently of teosinte, it is now extinct, or as yet undiscovered despite extensive searches for it. While it is logically impossible to prove that such corn never existed as a wild plant, I see no compelling evidence whatever to indicate that it did.

Let us examine the alternative, and to me more plausible, interpretation: that these oldest cobs represent stages in the transition of teosinte to corn through human selection.

First, it is obvious that these ancient cobs are much closer morphologically and genetically to teosinte than are the cobs of modern corn. The very simple reason is that cobs closely matching them are readily recovered in second- and later generations of corn-teosinte hybrids—as Mangelsdorf has indicated and as we have shown in our recent hybrid populations.

Second, this earliest corn is said to have had brittle cobs. If indeed they did, this would indicate teosinte ancestry, as I mentioned earlier. The trait would be a persistence of the brittle rachis in teosinte (by which means it scatters its seeds), and could reasonably be expected to have persisted for some time after teosinte was deliberately cultivated.

Third, some of the earliest cobs are two-ranked—that is, had two rows of kernels—another teosinte trait.

Fourth, these earliest corn cobs are reported to have had long, soft glumes —that is, leaf-like "flaps" covering each kernel, as similarly the leaf-like husks cover the whole cob. A modern mutant corn called tunicate or pod corn has similar structures. In ordinary modern corn these tunicate "flaps" are reduced to chaffy scales on the cob that cannot be seen until the kernels are removed. Mangelsdorf and his associates have suggested that the early archaeological corn could well have had the genetic equivalent of the modern tunicate trait. In fact, Mangelsdorf has used tunicate types of modern corn in breeding reconstructions of a close approximation to these earliest archaeological specimens.

To elaborate on the tunicate trait, I believe it to have had a far more important bearing on the origin of corn than has previously been recognized. It suggests how in a simple and plausible way teosinte could have been converted into a more useful food plant and a logical precursor of corn. Professor Galinat has generously provided me several strains of hybrid teosinte which carry the tunicate gene from corn. With these I have produced many additional strains by backcrossing to teosintes. The resulting modified teosintes have just the characteristics Emerson postulated as the first steps in a teosinte-to-corn transformation. Their fruitcases are reduced to shallow, softened, cup-like structures, and the glume "flaps" which protect the kernels, sealing them within the fruitcase, are enlarged and also softened so that even a fingernail can scrape one off to reveal the kernel underneath. In addition, the abscission cell layers between the fruits are less well developed, with the result that there is much less tendency of the teosinte spikes to shatter upon ripening. Thus a single mutation could transform teosinte with its hard shell-like fruitcase sealed by the hard glume "flaps" into a plant from which naked kernels can be threshed with ease. However, though this mutation would have been advantageous in the beginning of the transformation of teosinte to corn, getting rid of it would have been advantageous in subsequent stages of evolution through domestication from primitive to more modern corn. That is, further selection was toward more and more reduced glumes, or tunicate "flaps," so that completely naked kernels could be removed from the cob without threshing.

Left: To convince himself it could be done, Dr. Beadle ground teosinte on a primitive *metate* borrowed from Field Museum; it is similar to ones known from 6,000 B.C. in central Mexico. He is likely to offer an interested visitor teo-tortillas (in foreground) made from teosinte meal. Photo by Ed Jarecki. *Right:* The *metate* is still used for grinding corn into meal. Photo by William Madsen.

Teosinte as a food plant

One of the arguments against teosinte as an ancestor of corn has been that it is not obvious how its nut-like seeds with their heavy "shells" could have been used for food by primitive man. This view has persisted despite early Spanish evidence that teosinte seeds were indeed used as food. Garrison Wilkes in his book *Teosinte* mentions several codex references to teosinte being used as human food. Also, young teosinte stalks were undoubtedly chewed, as archaeological evidence indicates early corn was. Young spikes can be eaten before the cases become hardened.

In 1939, without knowledge of any documented use of teosinte as food, it occurred to me, as a boyhood lover of popcorn, that perhaps teosinte seeds would pop. A simple experiment demonstrated that they do. The popped kernels exploded out of their shells are indistinguishable from popped corn.

One is popped corn, the other popped teosinte; which is which?

More recently, as a result of a friendly disagreement with Professor Mangelsdorf on the edibility of ground whole teosinte seeds, in which he expressed doubt as to whether one could tolerate ingesting the fifty per cent or more roughage contributed by the shell, he suggested we appeal to Professor Nevin Scrimshaw, biochemist-nutritionist of M.I.T., whom we both know and who has worked in the tropics with teosinte. We did so, and Scrimshaw proposed that I do the following experiment: Consume 75 grams of whole ground teosinte seeds on each of two successive days. If I experienced no ill effects, increase the intake to 150 grams per day for two more days. If there were still no unpleasant consequences, I would have made my case. I completed the experiment with no ill effects whatever.

I have also had a try at cracking dried teosinte seeds with the same kind of primitive grinding-pounding stones that pre-Columbian Indians used, the *metate* and the *mano*. Field Museum kindly let me use archaeological specimens for this experiment. I convinced myself that an energetic person inspired by extreme hunger could in one day separate from the shell-kernel mixture enough shell-free teosinte to feed a small family that day. I have also satisfied myself that one can consume whole teosinte seeds without great difficulty by first soaking them until they have been sufficiently softened to masticate.

Linguistics

Such linguistic evidence as exists is consistent with the teosinte ancestry of corn. As pointed out by Professor Wilkes, in the Nobogame area of Chihuahua teosinte is known as *madre de maiz* (mother of corn), presumably from an earlier native designation. Does this term represent a kind of cultural memory? With many other existing native names for teosinte in the various parts of its range, this would appear to me to be a rewarding area for linguistic study.

Four cribs of corn on a page of the tribute lists of Montezuma, as shown in the *Codex Mendoza*. Each individual town conquered by the Aztecs had to pay particular kinds and quantities of products as annual tribute; corn was frequently an item.

Folklore

Regional folklore might also contribute to further understanding of the role of teosinte in prehistoric times. The Wilkes monograph clearly indicates this. It records that Lumholz, who traveled extensively in Mexico at the turn of the century and reported his observations in considerable detail, noted that in the Nobogame area teosinte growing in or near fields of corn was said to be "good for the corn."

Of course, it is easy to minimize the significance of such an assertion by assuming it to be an excuse for not making the effort to weed the interloper out of corn plantings. In fact, there is good evidence that teosinte *can* be "good for the corn."

Under primitive conditions of culture in which corn is grown in small areas, often relatively isolated from other corn, seed is saved from each crop for successive plantings. Inbreeding is thus intensified, and this we know reduces vigor and yields. If teosinte grows adjacent to or in such isolated plots, hybrids between it and corn occur. The frequency depends on a good many factors, such as relative times of pollination and spatial relations. When corn is pollinated by teosinte, the resulting hybrid kernels are usually indistinguishable from pure corn and thus may be chosen for planting. The resulting first-generation hybrid plants exhibit marked hybrid vigor. But, like *Zea canina*, the ears are small and undesirable and therefore will not be chosen as seed for the succeeding crop.

However, these hybrid plants will have shed abundant pollen, which will be widely disseminated because of the plants' tallness and vigor. Thus the hybrids will be male parent in backcrosses to corn in the next generation. Some of the backcross product will be good corn showing marked hybrid vigor and increased yield. Second- and later generation backcrosses to corn result in an even higher frequency of high-yielding good corn plants. In this way the corn will be rejuvenated according to the same principles used in producing modern high-yielding corn hybrids.

Such rejuvenation has been demonstrated in a well controlled experiment by Lambert and Leng of the University of Illinois, Urbana. These investigators hybridized a well adapted, high-yielding, inbred line of corn with four races of teosinte and made several successive backcrosses to the inbred corn parent. Yields in the second and third backcrosses were increased as much as 100 per cent.

Such hybridization is not infrequent in parts of Mexico where corn and teosinte grow close together, thus creating populations in which teosinte and corn genes are exchanged regularly at a rather low frequency.

Space does not permit a more detailed presentation of my findings bearing on the teosinte-corn relation. I can only say that I judge them to lend additional support to the view that a teosinte of some 8,000 to 10,000 years ago was the direct ancestor of corn—and was converted into corn over a period of many centuries through human selection.

Dr. George W. Beadle is President Emeritus and now Professor at the University of Chicago and Adjunct Professor at the University of Illinois, Urbana. He was co-winner of the Nobel Prize for physiology and medicine in 1958 for his work in genetics. This article is a modified version of the first Donald Forsha Jones Memorial Lecture, which Dr. Beadle presented at the Connecticut Agricultural Experimental Station, New Haven, Connecticut on September 14, 1972.

the two REVOLUTIONS

BENNET BRONSON & WILLIAM BURGER

To domesticate something is to tame it, literally "to bring it into the home." The word makes most people think of taming animals: the wolf for instance becomes a dog, or a wild aurochs becomes a common cow. But "domesticate" also applies to plants. Men have, all told, domesticated a great number of different kinds of plants and a small number of animals to produce a very impressive defense against famine. Hence the taming of wild plants was one of the crucial "events" in human history.

We are talking about this idea for two reasons—partly because Dr. George Beadle's article here is related to it, but also because, coincidentally, it is the basis of the theme of a new exhibit that Field Museum is planning. It will be an introduction to the hall of Economic Botany, the relationship between Man and Plants. People from both the Anthropology and the Botany Departments are involved in planning it.

The theme decided on for the exhibit is that there have been two great revolutions in the relationship between human beings and the Plant Kingdom. The first one started 10,000 years ago: the so-called Agricultural Revolution that followed the initial discovery of farming. The second one is happening even now: the Green Revolution of the 19th and 20th centuries.

The main effects of the Agricultural Revolution had to do with demography —the size and density of human populations. We could think of it as affecting mainly the quantity of life. The Green Revolution is having an important effect on the quality of life.

Men probably started planting and caring for crops because it was easier or more secure than gathering wild plants. But once they had started, they discovered they had in their hands a tremendous new resource of food energy. Not all food plants worked out so well, but a few did. Certain key crops allowed thousands to live where previously only a handful had roamed.

Most important were those members of the grass family that produce the cereal grains—corn, wheat, rice, barley, and rye especially. These were the basic foodstuffs that fueled the world's first great civilizations. And they continue to feed hundreds of millions of people today.

Why did early farmers pay so much attention to grass seeds? For the same reason that insects, birds, and animals do. Seeds are exceedingly nutritious; they contain proteins and fats in much greater quantity than does the rest of the plant. Also, they are splendidly packaged and storable, having been "designed" to protect an unborn generation through harsh winters and long dry seasons with enough stored food to produce vigorous new seedlings. And in much of the world grass seeds are the most numerous of all seeds. They grow so densely that hundreds of thousands of them may be found in a single acre. So the opportunity was clearly there—to take advantage of nutritious, storable food from productive plants that grow on the steppes and savannahs and prairies of half the world. Early man simply picked up the option that his environment offered him.

Domestication was no simple process. Men had wandered the globe for 3,000,000 years before they began to transform wild plants into tame crops. They must have begun haphazardly, almost accidentally. Perhaps they brought seeds or other plant parts to their shelters and then threw some away, thus encouraging useful plants to grow in and adapt to the fertile but disturbed ecology of human neighborhoods. Perhaps they made an effort to gather only the largest and least insect-eaten plants. Thus, when some were thrown on garbage heaps, they began, without knowing it, the long selection process that has caused domesticated plants to become larger and more productive.

Then as the selection process created more productive plants (from man's point of view), the stage was set for the really big step. People had to save the seed over the non-growing season, prepare the area to be planted, and plant the seed at the beginning of the next growing season. More had to be learned about seasons, water, soils, and fertilizers. Much more had to be done to improve plants themselves before they could be counted on as a staff of life. But the great step had been taken, and the first revolution, the Agricultural Revolution, began to flower.

Populations grew, techniques were perfected, scattered villages appeared. After only a few thousand years, towns appeared, then cities, then civilization itself.

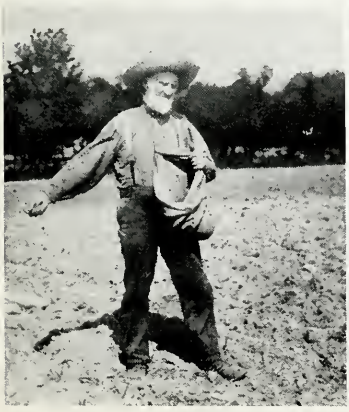
Ancient agriculture peaked at that point. At its best, as in Egypt, Rome, China, and parts of Africa, Peru, and Mexico, it was very good farming indeed. Large cities were fed and enough people were freed from the labor of daily food-getting to produce the great religions, monuments, and arts of those days. But ancient farming had its limits, for only a certain number of people could be thus freed and fed. The number of non-farmers and the size of cities were not much different in the Roman Empire than in Sumeria 2,000 years before, or in Western Europe in Shakespeare's time. The world was on a plateau and stayed there for more than 3,000 years.

The roots of the second great revolution in man's control over nature lay in the Renaissance and Reformation over 400 years ago. As men renewed the search for knowledge, they also developed a critical and skeptical attitude that gave rise to something entirely new: the scientific method. If it could be characterized by one sentence, that sentence would be a question: What is the evidence? No longer was it enough merely to proclaim "truths" or conclusions based only on formal semantic logic; experiments had to be devised to test ideas. The key that opened doors through which men had never passed before had three parts: hypothesis; experiment or observation to test the hypothesis; and verification by others of those experimental results or observations.

But it is not a foolproof, failsafe method, for interpretation enters into the method at many points. Hence the best of minds can, and often do, interpret evidence differently. Nevertheless, the method gave birth to science and to an explosion of technology which has made a new world.

The Green Revolution is thus a particular branch of the Scientific Revolution, the impact of which came

Opposite page: Illustrations of Aztecs planting, harvesting, and storing corn, from *Historia general de las cosas de Nueva España* by the Franciscan Bernardino de Sahagún, who went to Mexico in 1529. *Below:* Sowing and reaping in 19th century America.



Literal horsepower was still often combined with machine power in the 1920s to harvest the "amber waves of grain." Photo courtesy of International Harvester Co.

slowly to agriculture. Beginning about 1750, new industries in Western Europe were demanding workers—many more workers than could be freed from the land by any kind of farming previously known. For the next hundred years there were attempts to introduce more rational farming methods: crop rotation, fertilizing, and techniques for estimating the profitability of farms. Then beginning about 1850 the results of technology and industry began to feed back into farming. Machines—multiple plows, seed drills, threshers, harvesters, and tractors—began to replace manpower and horsepower. Agricultural productivity in the wealthy industrialized countries increased a hundredfold, and now just a few farmers could feed a hundred city dwellers.

But it wasn't until the beginning of the 20th century that the Green Revolution began for most of the people of the world. The new, industrialized agriculture already established was of little benefit to Indians or Indonesians or Africans or Brazilians. They could hardly afford to buy a hoe, let alone a tractor-drawn plough. For them the Green Revolution began with the explosion of knowledge in genetics (stemming from rediscovery of Gregor Mendel's laws of heredity), statistics (based on the mathematics of an agricultural researcher named R. A. Fisher), pedology, agronomy, and a host of other disciplines in the areas of plant nutrition, crop protection, and produce handling. Agronomists, chemists, and soil scientists invented new methods of fertilizing and handling the soil. Plant geneticists began to breed new varieties from the genetic building blocks provided by botanist-explorers who fanned out through the countrysides of the world looking for the oldest and most genetically variable kinds of plants. They crossed, recrossed, backcrossed, selected, tested, reselected, and tested again, often using the simplest of equipment in combination with the ideas of Mendel and Fisher. Out of all this, within the span of one lifetime, has burgeoned a cornucopia of new crop varieties. They produce more food for more people in more places than men dreamed of just a generation or so ago.

Photomicrograph of the ten pairs of chromosomes of corn in a pollen mother cell, from a slide prepared by D. T. Morgan, Jr. Genes lie on chromosomes like beads on a string.

The science of genetics has played one of the most significant roles in this Green Revolution. Knowing the origins and wild relatives of a crop plant is essential in any breeding program. These wild relatives are often the source of important characteristics that can be added to a crop variety or they can serve as a reservoir of genetic variation to be tapped when the breeder faces new problems, such as a new disease. It is for these reasons, among others, that a knowledge of the true ancestor of Indian corn, or maize, is so important.

The work Dr. Beadle describes in his article about the origin of corn—his experiments, observations, and arguments—is the kind that created, and that is necessary to sustain, the Green Revolution.

Bennet Bronson is Assistant Curator, Asian Archaeology and Anthropology, Department of Anthropology; Dr. William Burger is Associate Curator, Vascular Plants, Department of Botany, at Field Museum.

FIELD BRIEFS

Mr. and Mrs. Ray A. Kroc Make Major Contribution to Museum

In September Mr. and Mrs. Ray A. Kroc made a generous contribution to Field Museum of $450,000. The gift marked the occasion of Mr. Kroc's birthday.

The gift was also an expression of the personal philosophy of Mr. Kroc, who as the founder and chairman of McDonald's Corporation, saw his business expand from a single restaurant in 1955 into a national and international chain of more than 2,100 today. "Such a dream could be realized only in America," he said. "On my 70th birthday, my greatest pleasure is the opportunity to share my good fortune with others."

Because of Mr. Kroc's interest in ecology, his gift will be used to help support a comprehensive public education program at Field Museum in 1974: "Man in His Environment."

The Museum's large collections and the expertise of its scientific staff put it in an especially favorable position to provide the kind of unique public education experience that "Man in His Environment" will offer to millions of people. The program will include a semi-permanent exhibit at the Museum, a traveling version of the exhibit, and films, lectures, and publications. All of these components will offer significant help to the layman as he is called upon to become more and more involved in making intelligent decisions regarding environmental problems.

Mr. Kroc's birthday celebration went even further than his personal gift toward helping the Museum's work. His friends and business associates chose to honor him by establishing the "Ray A. Kroc Environmental Fund" at Field Museum. It too will be used to assist the Museum's research and education in the ecological and environmental sciences. To date, more than 240 friends of Mr. Kroc have made contributions to the fund, which presently totals approximately $100,000.

Congressional Subcommittee Members Learn Museum Financial Needs

Officials of major Chicago area museums testified at a hearing held by the Congressional Select Subcommittee on Education September 23 at Field Museum to inquire into the critical financial needs of museums.

Listening to the testimony were Congressmen John Brademas (D., Ind.), chairman of the hearing, and Dan Rostenkowski (D., Ill.) co-sponsors of a bill to establish a $40 million fund to assist in the operation of museums over a three-year period. Their proposed Museum Services Act, known as H.R. 8677, would authorize federal funds to meet up to 50 percent of the cost of renovating museum facilities, installing exhibitions, providing trained staff, and general administration expenses.

Participants at the hearing included representatives of Field Museum of Natural History, the Museum of Contemporary Art, the Museum of Science and Industry, the Chicago Historical Society, The Adler Planetarium, The Art Institute of Chicago, the Milwaukee Public Museum, and the Northern Indiana Historical Society of South Bend, Indiana. Daniel J. Shannon, president of the Chicago Park District, also testified.

Congressman Brademas noted that "Museums of art, science and history are a vital part of our national educational and cultural life, and they are now reaching out into the community in new ways to serve still wider audiences. But there is evidence that museums have reached their limit in meeting the rising costs of their services. Increased expenses for trained personnel, exhibit space, conservation, building maintenance —these are only some of the reasons for the financial crush many museums are enduring."

He further observed that "thirty years ago, attendance at the nearly 6,000 museums in the United States totaled some 50 million visits annually. Today that figure has reached nearly 700 million and is still climbing."

The hearing was part of a careful study by the Subcommittee of the changing role of museums in American life, the problems they face, and the appropriate means of federal support for them. A similar hearing has been held in Washington, D.C., and further ones are planned next year in New York City, Los Angeles, and other communities in various parts of the country.

Mr. and Mrs. Ray A. Kroc

Left to right: Congressman Dan Rostenkowski (D., Ill.); Congressman John Brademas (D., Ind.); Emory Williams, president, The Adler Planetarium (rear); Marshall Holleb, member of board of trustees, Museum of Contemporary Art; Colonel S. N. Black, comptroller, The Art Institute of Chicago; Clement M. Silvestro, director, Chicago Historical Society; Joseph M. Chamberlain, director, The Adler Planetarium; and E. Leland Webber, director, Field Museum of Natural History.

Capital Campaign Section Executives Meet

Six Chicago area business leaders representing the finance, investments, and insurance section of Field Museum's $25,000,000 Capital Campaign included a tour of the paleontology laboratory when they met last month to coordinate their part of the capital fund drive.

Gordon Bent led the meeting as chairman of the section, assisted by Nicholas Galitzine, who is general chairman of the campaign.

These executives have joined with 37 other businessmen volunteers, all from the ranks of top management, to carry the Museum's case for corporate support to the business community of Chicagoland. The target of this phase of the Capital Campaign is to call upon some 1,200 business firms, plus corporate and private foundations.

Each member of Mr. Bent's section, like the volunteer members of nine other sections of the corporate division of the campaign, will personally visit many companies to tell the Field Museum story. The vital role of these executives is to develop prospects for capital gifts and also to attract colleagues to join them in the campaign.

This first Capital Campaign in the Museum's 79-year history was announced in September 1971. Its goal of $25,000,000, urgently needed for rehabilitation and improvements to the Museum's building and facilities, should be reached by September 1974. The Museum must raise one-half privately in order to receive matching funds for capital improvements through the bonding authority of the Chicago Park District. To raise its share, the Museum has organized a solicitation of individuals, corporations, and foundations.

Gifts already generated by the corporate division alone, including Mr. Bent's section, presently total $2,100,000.

Hotline to Museum Membership

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CALENDAR

Exhibits

Opens November 11

Greenland: Arctic Denmark, a major exhibition covering all aspects of the history and culture of the world's largest island. The extensive collection of archaeological and ethnological material is supplemented by photographs and a daily film program to illustrate various areas of economic development and social change in modern Greenland. The exhibition is sponsored by the Royal Danish Embassy and is shown under the auspices of the Smithsonian Institution Traveling Exhibition Service. Through March 8. Hall 27.

Opens November 13

Paracas Whistling Jar from the Ica Valley of Peru, Ocucaje Phase II (ca. 700 B.C.), is featured in the South Lounge through January 21. The unique pottery jug, which makes a whistling sound when water is poured out of it, is the earliest known of its type. It is the gift of Mr. and Mrs. Raymond J. Wielgus.

Continuing

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit explaining the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through March 25. Hall 9.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. Continues indefinitely.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with the physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Film and Tour Program

Fall Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

November 11: **"Hawaii,"** narrated by Norman Schley.

November 18: **"Saga of the Inca Empire,"** narrated by Geza De Rosner.

November 25: **"The Little Things in Life,"** narrated by Fran William Hall.

Weekend Motion Pictures at 1 and 3 p.m. Saturdays and Sundays in the second floor North Meeting Room. Each program includes two films: **"Fire Mountain,"** describing the second greatest eruption of Mt. Kilauea in Hawaii, and **"Continental Drift,"** exploring the origin of our continents.

Children's Program

Continuing

Fall Journey for Children, "Archaeology in the Midwest," a free self-guided tour. Youngsters are provided with a questionnaire which routes them through Museum exhibit areas. It helps them to reconstruct the story of human happenings in the Midwest from the arrival of the first Indians until Europeans began recording the history of this area 300 years ago. All boys and girls who can read and write may participate in the program. Journey sheets are available at Museum entrances. Through November 30.

Meetings

November 14: 7:30 p.m., Nature Camera Club of Chicago.

November 14: 8 p.m., Chicagoland Glider Council.

November 28: 7:30 p.m., Nature Camera Club of Chicago.

Coming in December

Winter Journey for Children, "Dog Meets Man," begins December 1. The free, self-guided tour explores the many aspects of man's partnership with "his best friend" since prehistoric times. Through February 28.

Film and Guided Tour Program, December 26 through 29. "Through These Doors," a color film focusing on behind-the-scenes activities at the Museum, is shown at 1:15 in the second floor North Meeting Room. A "highlights" tour leaves at 2 p.m. from the north information desk.

November Hours

9 a.m. to 4 p.m. Monday through Thursday, 9 a.m. to 9 p.m. Friday, and 9 a.m. to 5 p.m. Saturday and Sunday. On Thanksgiving Day, November 23, the Museum will be open from 9 a.m. to 5 p.m.

The Museum Library is open 9 a.m. to 4 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410

olume 43 Number 11
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Field Museum of Natural History Bulletin

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Volume 43, Number 11
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Mother and infant Mountain Guereza.
Photo by Leland LaFrance.

2 **The Mountain Guereza**
Robert Horwich and Leland LaFrance
a picture-story of behavior and development of a zoo-born infant within its "extended family" troop

6 **On Being Mother to a Tiger**
Joyce Marshall Brukoff
why a zoo nursery is necessary and how it functions

9 **Greenland, Robert E. Peary, and Field Museum**
James W. VanStone
the current special exhibit "Greenland: Arctic Denmark" reminds a curator of Field Museum's first connections with the island, through Peary, more than 80 years ago

12 **Book Reviews**

15 **Capital Campaign**

16 **Field Briefs**

Calendar

Field Museum of Natural History
Director, E. Leland Webber

Editor Elizabeth Munger; Editorial Assistant Vicki Wilson; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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The Mountain Guereza

Robert Horwich & Leland LaFrance

Research is an important activity at the Chicago Zoological Society's Brookfield Zoo facility, under the guidance of its Director, Dr. Peter Crowcroft, and its Associate Director for Research and Education, Dr. George Rabb. Dr. Rabb's dual responsibilities are not just coincidence. The philosophy behind research at Brookfield Zoo is that it should contribute information about animals that can be incorporated into the zoo's public education program as well as develop new knowledge to share with zoologists at other zoos, at universities, and at natural history museums. A sample of some of that research is presented here.

Zoos and natural history museums are naturally complementary, and zoo and museum curators have traditionally worked closely together. In fact, encouraging zoos to undertake research on their animal populations was a particular interest of Karl P. Schmidt, Field Museum's renowned Chief Curator of Zoology from 1940 until 1955, and of Alfred E. Emerson, the distinguished Professor of Zoology (now Emeritus) at the University of Chicago and Research Associate at Field Museum. Drs. Schmidt and Emerson were both long-time trustees of the Chicago Zoological Society and were instrumental in the initial appointment of a research zoologist at Brookfield Zoo. The tradition of cooperation between the two institutions was carried on by Dr. Austin L. Rand, the Museum's Chief Curator of Zoology from 1955 to 1968, who contributed so much to popularizing natural history education; he was chairman of the zoo's scientific advisory committee.

Recently, as part of a long-term zoo research study, a perceptive ethologist and a patient photographer began filming the behavior of a captive troop of Mountain Guerezas, Colobus guereza, shortly after the birth of its youngest member. These animals are a species of social, leaf-eating East African monkey that lives in close-knit troops of two to thirteen individuals, composed typically of a single adult male, one or more adult females, and their offspring of varying ages. Within the tropical rain forest that is their natural habitat each troop maintains its integrity and territory through visual and vocal displays.

Dr. Robert Horwich and Leland LaFrance selected and organized parts of the film footage to show three stages of growth of the infant within its social matrix: mother-infant unity; individuation; and socialization. The picture-story presented here was taken from their completed 24-minute color film, with voice narration, which is now being prepared for general distribution. Inquiries about the film should be directed to the Education Department, Chicago Zoological Society, Brookfield, Illinois.

Dr. Robert Horwich is Research Zoologist, Leland LaFrance is Photographer at Brookfield Zoo.

Mother-infant unity

The white newborn Mountain Guereza begins life on the nipple. Here it finds food and security.

Other females in the troop show great interest in the newborn. The mother allows them to take and carry her baby. These infant transfers may occur during the infant's first day of life. Despite the extra attention of the other females, the two-month-old infant prefers to be with its own mother and on her nipple, often returning to her immediately following a transfer. This may discourage transfers.

The other females mouth, sniff, and groom the infant—even more frequently than does its mother. Females often sniff or kiss the infant's back during and immediately after a transfer.

During the first part of its life, the infant constantly uses its mother's nipple as an ever available source of security.

Individuation

As the infant's pelage starts to change to adult coloration, a period of intense scratching begins. The relationship to pelage change is uncertain.

Scratching, when it first appears, is uncoordinated, arhythmic, and often misplaced, sometimes even missing the infant itself and ending on the mother. Those scratches falling on itself may give feedback to help the individuation process. Scratching, like other individuation behaviors, begins in an uncoordinated manner, but becomes more integrated as the infant develops; specifically, scratching becomes more directly placed and shorter in duration.

The infant gains identity as it pays more attention to itself than to the comfort it has with its mother.

The infant moves out from the maternal cavity more and more. It reaches out, explores things, explores itself, and explores other individuals in the troop in an asocial manner.

Although the Colobus monkey doesn't ride on its mother's back during transit as baboons do, it, like other Old World monkey babies, does climb on her and use her as a base for pre-social play. The female tolerates the infant's behavior, although it sometimes appears to be annoying to her.

Individuation marks the beginning of an interest in solid food. The infant shows interest in the food its mother eats by sniffing her mouth, as do other individuals in the troop. Such sniffing is common in most Old World monkeys; it seems to give the other troop members an idea of what the individual is eating.

There is a period of mouthing of various objects. This is common in many other Old World monkeys and in humans. The infant mouths its own hand as well as parts of its mother. Mouthing is an important behavior of this individuation period. At the same time the hands begin to manipulate and explore objects as the infant grows. Later the infant integrates the use of its mouth and hands.

Socialization

Lip-smacking occurs consistently in social contexts after about 50 days of age, indicating that the infant is moving into the socialization period. Though lip-smacking is first noticed at 18 days of age, at that early stage it is outside of social context.

The infant lip-smacks as it shows great interest in the dominant male. The male may respond by lip-smacking and gently pulling the infant's head toward him. Earlier in the infant's life the male has few interactions with it. As the infant grows, the male may carry it occasionally. The young male may repeat some of the mild interest the dominant male shows, cupping the infant under the chin. He may capture the infant as it travels by itself. He may attempt to carry the infant but is unable to control it as well as adult females do.

As the infant develops socially, it is controlled more by the others in play. Often it responds from the security of the maternal cavity. It shows great interest in the play of other troop members.

Social play in *Colobus guereza* is common in older juveniles and adults. In captive troops, all individuals play at one time or another, including adult females. They play with other adults as well as with the young of the troop, although play most often occurs between individuals of similar ages. With individuals of different ages, the older one seems to modify the intensity or roughness of the play, being more gentle with the younger individual. Play includes a great deal of mouthing of each other's face, arms, hands, and feet. Occasionally play ends in grooming.

The period of intense mothering of the infant gives way to a gradual disenchantment, until scenes such as this rejection of a five-month-old infant become common.

But the youngster is allowed to find some security on the nipple until it is over a year old. From the security of the maternal cavity, that holds the Guereza baby between womb and entry into a group of adult peers, the young monkey passes from mother-infant unity through individuation to gradual weaning, and on into adult socialization.

Out of the infant comes the adult. The Guereza troop renews itself.

Tiger! Tiger! burning bright
In the forests of the night,
What immortal hand or eye
Could frame thy fearful symmetry?

Did he smile his work to see?
Did he who made the Lamb make thee?
William Blake

on being mother to a tiger

joyce marshall brukoff

There is little resemblance between the fearful beast described by William Blake and Tigger, a striped baby in the nursery at Lincoln Park Zoo. Playing with a ball on the nursery floor, this house-cat-sized tiger is as endearing as any baby, as are its animal "tot" companions—a brilliantly spotted jaguar, about the same age as Tigger; the bumbling and temperamental queen of the nursery, Kumba, prize two-year-old gorilla; two puma youngsters; a miniscule snow leopard, who spent her first few weeks in the incubator; and Carla, a black leopard, growing large now, and soon to be transferred to her own quarters in the big lion house.

Unfortunately the old axiom "everybody loves a baby" doesn't always hold true. In the case of animals in captivity, the exception to this rule can often be the animal's mother. Naturally, animal behavior under the conditions imposed by any zoo will be altered from that in the wild. Many lucky babies are loved and cared for in normal fashion. Other newborns are rejected—sometimes even harmed by the mother—and so must be removed to be saved. Some of the older zoo buildings do not have adequate cubbing dens for the mother to retire to prior to giving birth. That is the primary reason for the nursery at Lincoln Park Zoo. Here, as part of the children's zoo, a controlled environment is offered for very young animals under the supervision of a qualified animal keeper. There they are raised to a point of maturity when they can be safely placed in their own area of the zoo, or perhaps sold or traded to another zoo where this specimen is in demand.

While saving the lives of many infants, the nursery also provides a unique place for the zoologist to study the behavior of these very young animals. Much can be learned about them as each one struggles to adapt to the diet, colds, exposure to other animals, and varied trauma of growing up. What is learned will fill the pages of research reports as well as allow the nursery programs to be improved as each new group of babies comes along.

A third and very important function of the nursery is to provide the public with a close-up view of the young animals. The faces of children are radiant as they look through the glass to observe, just inches away, a tug of war between a two-foot-long jaguar and a bit of cloth caught under the wheels of a toy wagon. They have watched Kumba flee from a tiny puma one-tenth her size—and then later, when the puma least expects it, Kumba's arm come sneaking out to yank the spotted tail. They watch as Jill, the sloth with the huge eyes and the indolent air, drinks milk from a tiny baby bottle. They watch the Geoffrey marmosets, minute primates from South America, chatter excitedly over a plate of finely diced fruits and vegetables.

A Geoffrey marmoset.

A puma baby tries solid food.

As they watch, they learn—and, hopefully, they begin to love and understand the living world better, growing up to protect the vanishing animal populations of our globe. One feels much closer to a tiger or an orangutan when one sees the animal at this most beguiling time of its life.

A few afternoons at the children's zoo will leave an indelible mark on the sensitive child's mind such as no amount of reading *Ranger Rick* or an animal book will do. Maybe he will remember to care when it's his turn to act.

Few people can be unaware these days that we are faced with the almost sure extinction of many species. Certainly there are a number which will always remain very rare, even if the utmost effort is made to save them. In recent years the idea of cooperative "zoo banks" has caught on. The premise is that zoos must continue to raise and keep animals that are rare or actually extinct in the wild as our last chance to save these species from total and eternal oblivion.

The nursery is an important part of this strategy. If indeed we are to have this tremendous responsibility—if some day the fate of the cheetah or the lowland gorilla hangs on our ability to keep these animals alive and well in captivity—we had better be ready.

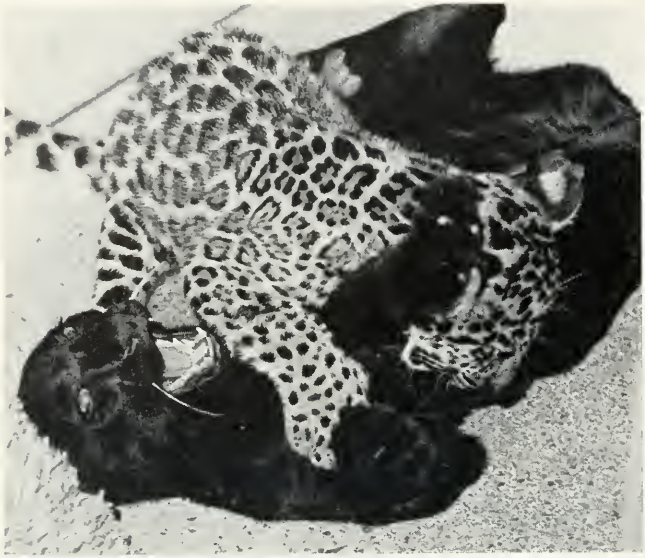
Working under the keeper at the nursery are a group of women volunteers who are meticulously trained in the care of the baby animals. The nursery is sealed off by glass from the rest of the children's zoo, and guests inside are infrequent. All workers must wash thoroughly when coming in, wear uniforms, even special shoes, and all foods and medicines are prepared and handled in a spotlessly clean kitchen within the confines of the nursery.

Some animals are more difficult to raise than others and require special attention. And, quite frankly, they don't always make it. But as time goes on, more and more survive. Each animal that shows signs of weakening in any way is given all the special attention of a heart patient in an intensive care unit. Dr. Lester Fisher, director of Lincoln Park Zoo, and Dr. Eric Maschgan, consulting zoo veterinarian, are always within reach to advise and give medication. The sick animal is completely isolated from other residents of the nursery. Charts of other animals of the same species who are graduates of the nursery are checked to compare symptoms and treatments. The trained men who keep vigil throughout the night are carefully briefed. The zoo curatorial staff remain on call at their homes nearby or, as they have many times, remain on the scene most of the night.

Everything possible is done to save a sick animal, but naturally some die. Then an autopsy is performed, from which more is learned. Thus, as time passes, problem after problem is conquered, and each new animal has a greater chance for adulthood.

The routine in the nursery is simple, and usually very busy. We play with the animals as much as possible, for they need the warmth of cuddling and the excitement of romping, as do human infants and youngsters. But most of what nursery volunteers do can be classified as work. It all depends on how many animals are there. When there is a full house, everybody must scurry from the time work starts—7:30 a.m.

The day begins with cleaning cages.



Jaguar and black leopard "kittens" during playtime in zoo nursery.

Shy Kumba and author. Photos by Ed Jarecki.

This includes taking all the animals out and letting them play while the night's droppings are scrubbed away.

The animals can be very playful in the morning, and hungry, so quick stepping helps avoid the stinging crunch of baby teeth on an unprepared ankle. It's also wise to watch the pail of soapy water. Carla, the black leopard, loves to tip it over.

After scrubbing, feeding—and then the preparation of formula for the day. This can be a long process, as usually each animal gets a different formula.

Then before lunch, if the weather permits, we take the animals out on a leash for a romp in the grass next to the children's zoo. After lunch there is washing dishes, sterilization of all the baby bottles, feeding again (twice—at 1:30 and again at 4, but it changes from time to time), perhaps another trip outside, and of course the constant cleaning up. This in addition to the daily weighing of very young animals, bath time, and many other chores too diverse to mention.

The animals play well together. Except for shy Kumba, we can put them all together on the floor and visitors can watch the ensuing circus through the glass. The tiger and the pumas chase each other or worry a big plastic bottle that is one of their many toys. The jaguar leaps from atop an upside-down chair onto the back of Carla, who is twice its size. Carla turns, and they become a mixed-up mass, rolling balls of black and spotted energy. And nobody gets hurt. From her cage Kumba reaches out her arm and slaps the jaguar on the top of the head. She wants to play, but is very selective. The tiger's OK; the jaguar is definitely not.

Kumba is so nervous about this rough playmate that our cleaning up job doubled every time she was put with the jaguar. She would rather play with the pumas on one side of the divider while on the other the tiger and the Jaguar go to it. Above it all, Jill the sloth hangs unconcernedly in her roomy cage with her "security" tree limb and her little hard chew toy. The marmosets chatter incessantly in their wire cage. And the faces of children press against the glass.

It is good that in a world where hunters are still poaching baby alligators, where ecologists are ringing the death knell for our environment, where we are making a desperate stand for the natural heritage of our wilderness areas, there is a place where men are vitally concerned with a few animal babies—the representatives of their species.

Perhaps one part of the battle for survival is being won in zoos, where it is the animals that come first. For some species, it is their last chance on earth.

But even if the species cared for are not endangered, zoos and their animal nurseries are of vital importance to museum zoologists. Their research on the diversity and interrelationships within nature's dynamic system encompasses all aspects of the animals. They need museum collections of skeletons and skins, but they study living forms too when possible. Often that can be done best in zoos.

Joyce Marshall Brukoff is a freelance writer specializing in natural history, and also a volunteer worker in the nursery at Lincoln Park Zoo, Chicago.

Greenland, Robert E. Peary, & Field Museum

James W. VanStone

Robert Edwin Peary

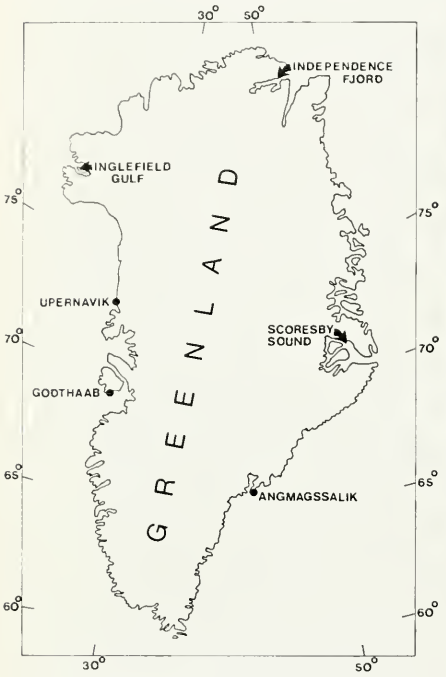
The traveling exhibition "Greenland: Arctic Denmark," which opened at Field Museum on November 11 and will run through March 8, 1973, recalls the circumstances of Field Museum's first involvement with Greenland research and exploration, more than 80 years ago.

In 1891 Frederic Ward Putnam, as Chief of the Department of Ethnology and Archaeology for the World's Columbian Exposition here in Chicago, was given the task of assembling a large anthropological collection for the 1893 fair. Field parties to various parts of the world were directed to collect ethnographic specimens representing many different cultures. One of these parties, an expedition to northwest Greenland, was under the command of Lieutenant Robert Edwin Peary of the United States Navy.

Lieutenant Peary eventually became a rear-admiral and received worldwide recognition for his arctic explorations, particularly his achievement in reaching the North Pole in 1909. In 1891, however, he was serving as Chief Engineer at the Philadelphia Navy Yard when he received an appointment to lead an arctic expedition for the American Geographical Society and the Academy of Natural Sciences in Philadelphia. It was during this expedition (1891-1892), the first of many to the remote country of the Polar Eskimo in northwest Greenland, that Peary made the collection for Putnam and the 1893 Exposition.

The North Greenland Expedition, as it was called, consisted of Peary, his wife, and five associates. The party left Philadelphia on June 5, and although the explorer broke a leg aboard ship a few days later, he was sufficiently recovered to direct the establishment of a permanent base camp at the entrance to Inglefield Gulf on July 25. The ship then departed and the little party prepared to spend the winter. The expedition's surgeon and ethnologist was Dr. Frederick A. Cook, who later gained considerable notoriety for his claims to have reached the North Pole before Peary. It is likely that the bulk of the ethnographic specimens collected for the World's Columbian Exposition were obtained by Dr. Cook.

This map of contemporary Greenland shows only a few of the many coastal towns and settlements; the interior of Greenland, which has an elevation of from 6,000 to 10,000 feet, is covered with glacial ice of great thickness.



Above: Eskimo-made maps carved of wood, from Angmagssalik, in "Greenland: Arctic Denmark" exhibit at Field Museum through March 8; largest map is probably an imitation of European maps.

When Peary's ship landed on the shores of northwest Greenland, he was greeted by the Polar Eskimo from villages in the vicinity of the expedition's camp. These remote people, who numbered less than 250 individuals at the time of Peary's visit, have long been famous in anthropological literature as the world's most northerly inhabitants.

Students in ethnographic survey courses are frequently told how this small band of arctic peoples, occupying a region well above 75° N. latitude, had lived in total isolation for so long that, when first contacted by the English explorer John Ross in 1819, they believed themselves to be the only people in the world. Following the explorations of Ross, the Polar Eskimo had intermittent contact with English and Scottish whalers and later, in the early 1850s, with expeditions in search of Sir John Franklin. Nevertheless, at the time of Peary's stay among them, the Polar Eskimo continued to be one of the most primitive and remote peoples to be found anywhere in the world.

It was in the spring of 1892 that the major work of the expedition was carried out. Departing from Inglefield Gulf in late May, Peary and one companion, proceeding overland by dog team, reached the head of Independence Fjord on July 4, thus determining for the first time the northernmost extension of the subcontinent. They were back at the base camp by August 6, and during their absence Dr. Cook had obtained a sizable collection of ethnographic specimens from Eskimos living in the vicinity in exchange for pieces of iron and brass, barrel staves, metal tools, boxes, and miscellaneous lumber fragments no longer needed by the expedition. While Peary was away, a ship from Philadelphia arrived to take the expedition home and, although delayed by the loss of one member of the party on a glacier near the base camp, the explorer and his remaining companions left Greenland on August 24, reaching Philadelphia exactly one month later.

The Peary collection of Polar Eskimo material culture consists of more than 250 items, including clothing, household utensils, hunting and fishing gear, and ceremonial equipment. At the conclusion of the World's Columbian Exposition, these objects together with other scientific collections which had been acquired with Exposition funds, were turned over to the Field

Items in "Greenland: Arctic Denmark" exhibit. *Top:* Runic stone (shown approximately life-size) found in 1824 at Kingigtorssuak, just north of Upernavik. It reads: "Erling Sigvatsson, Bjarne Thordarsson, and Eindride Oddsson erected Saturday before Rogation Day these cairns and runes well." Date is interpreted as April 25; type of runic letters places the year in the 14th century. *Below:* Typically armless carved wooden doll amulets, 2½ to 5 inches high, of the Thule culture, from Nualik, north of Angmagssalik. *Right:* Early 20th century water bucket, scoop, throwing stick for harpoon, and eyeshield, decorated with representations of the seal carved from bone.

Columbian Museum as a nucleus to found this institution, now Field Museum of Natural History. The material collected by Peary is thus one of the oldest collections in the Department of Anthropology, and although not on exhibition at the present time, is part of the Department's large reserve collections utilized by scholars for research purposes.

Virtually every explorer from Ross to Peary who had contact with the Polar Eskimo noted the small amount of wood and metal utilized by the people in the manufacture of their tools, utensils, and weapons. Such exotic materials as were available to the Eskimos have generally been attributed to contact with whaling ships, the various explorers themselves, and occasional wrecked ships or driftwood fragments. However, if Polar Eskimo material culture was relatively unaffected by outside influences until Peary's first expedition, we would expect his collection to be notably lacking in items utilizing iron and wood in their construction. This is definitely not the case. These materials were utilized extensively by the Eskimos who made the tools, weapons, and other objects collected by Peary in 1891 and 1892.

Trade materials such as wood and iron may have been introduced by migrating Canadian Eskimos in the mid-19th century or, more likely, they were obtained through trade with Eskimos to the south along the west coast of Greenland, where driftwood was plentiful and where there had been contact with European whaling ships in the 18th century. It would appear, therefore, that although the Polar Eskimo were, beyond a doubt, an extremely isolated people, they probably had more contact over a longer continuous period of time with the peoples of southwest Greenland and northeastern Canada than has been generally noted. It is therefore possible to doubt whether, even in Ross's day, the Polar Eskimo really believed themselves to be the only people in the world. Field Museum's Peary collection thus not only associates the institution with one of the most famous names in arctic exploration, it also provides us insight into the lifeways of the most northern human population.

Dr. James W. VanStone is Curator, North American Archaeology and Ethnology, and Chairman of the Department of Anthropology, Field Museum.

The Fuller Collection of Pacific Artifacts
By Roland W. Force and Maryanne Force. London: Lund Humphries, 1971. xvi + 360 pp. $35.

Since the turn of the century Field Museum has been justly world famous for the richness of its ethnological collections from the Melanesian Islands of the southwest Pacific. There are few museums that can rival, much less equal, the scientific and cultural worth of the great collections acquired from Otto Finsch, Richard Parkinson, J. F. G. Umlauff, W. D. Webster, W. P. Harrison, and especially those gathered out in the Pacific by two of the Museum's earliest curators, George Dorsey and A. B. Lewis.

By comparison, for decades the Museum's holdings from the Polynesian Islands east of Melanesia and from Australia to the south were small in numbers and very uneven in their representation of the native cultures of the farther reaches of Oceania. To be sure, there were a few exceptions: notably the Captain T. E. Donne Collection of Maori artifacts from New Zealand, and the large, old Maori council house that stands today in Hall F on the ground floor of the Museum. But the deficiencies were acute for most of the island cultures beyond Melanesia.

Then in 1957 Roland Force, at the time Field Museum's Curator of Oceanic Archaeology and Ethnology, first visited an elderly gentleman in London who was renowned as one of the greatest collectors of all time: Captain A. W. F. Fuller. Force has described him as one of the most memorable men he has ever met: "He was a gentleman in the most complimentary sense of the term. He was courtly and formal; even Victorian in his view of life."

Over the years since the acquisition of his first Pacific artifact in 1896, Fuller and his wife, Estelle, had carefully amassed a collection of over 6,000 items. Recognizing its great intrinsic worth, Force arranged for its acquisition by Field Museum through the generosity of a number of private citizens. From February to July of 1958 Captain Fuller and Roland Force cataloged every specimen on sound tape and packed each item for shipment to America.

The collection's arrival in Chicago was greeted enthusiastically. Field Museum's Annual Report for 1958 observed: "Together with the Museum's already excellent and comprehensive materials that emphasize Melanesia in particular, the Fuller Collection provides a source for scientific study and exhibition that ranks exceptionally high among museums the world over."

Roland Force, now director of the Bishop Museum in Hawaii, and his wife have at last issued the long awaited homage to Fuller and his collection. *The Fuller Collection of Pacific Artifacts* contains hundreds of superb photographs. Many reveal the artifacts in close detail. Unquestionably, those who are interested, as Fuller was, in things Pacific will want to add this large volume to their own libraries. It is not a catalog of specimens, one by one. Rather it is a vivid pictorial sampling of the esthetic and cultural richness of the great Fuller Collection.

by John Terrell, Assistant Curator of Oceanic Archaeology and Ethnology, Department of Anthropology, Field Museum.

Indian Life on the Northwest Coast of North America as Seen by the Early Explorers and Fur Traders during the Last Decades of the Eighteenth Century
By Erna Gunther. Chicago: University of Chicago Press, 1972. xiv + 277 pp.; illustrations; map. $15.

During the last three decades of the 18th century the northwest coast of North America was explored with varying degrees of thoroughness by four maritime nations, each with colonial or commercial ambitions toward the region. The Russians, perhaps the least dedicated to disinterested exploration, were first on the scene. Spanish explorers came north from California to keep an eye on the Russians, and the English followed to find out what the Spanish were doing. Following the establishment of a maritime fur trade, New England sea captains arrived and boldly intruded on the commercial operations of all the others.

In this superbly designed and well illustrated volume, Dr. Erna Gunther, an anthropologist with considerable field experience on the northwest coast, relates and interprets information in the journals of these explorers concerning the Indian inhabitants they encountered between northern California and about 57° north latitude. In the course of her research she also examined most of the known ethnographic specimens in the world's museums that were collected by 18th century explorers. This interrelation of literature and artifacts gives a new and vivid dimension to ethnohistory. Contemporary sketches, some rare and unpublished, are also utilized to provide as complete a picture as possible of the lifeways of northwest coast Indians at the time of first contact with Europeans. Lacking, however, are detailed maps that would have made it much easier for the reader to follow the progress of each of the many explorers and traders mentioned.

In the first chapter the author discusses the initial Russian explorations in the north Pacific together with the Spanish response. Next we are with Captain Cook at Nootka Sound, and the artifacts collected by members of the expedition, most of which are now in the British Museum, are described and illustrated. The drawings of the expedition's artist, John Webber, are carefully analyzed. Since several members of Cook's party published accounts of the voyage, Dr. Gunther gives multiple descriptions of certain incidents involving the Indians of Nootka Sound in order to ascertain the accuracy of the ethnographic data they contain.

In chapter 3 we follow the explorers along the coast south of Nootka to the Strait of Juan de Fuca and the Columbia River. Various Spanish explorers, American traders, and the Englishman John Meares figure prominently, but there are few known artifacts and drawings to supplement the written historical data. Also featured in this chapter are the southern explorations of the greatest seaman of them all, Captain George Vancouver. For his voyage, which began in 1790, there are numerous artifacts which have survived; unfortunately, few are illustrated. In the following chapter we follow the careful explorations of Vancouver as he works his way through the intricate channels of the Inside Passage.

Dr. Gunther devotes a chapter each to the Haida and Tlingit Indians, both powerful tribes who greatly impressed the first European visitors to their lands. The Haida were shrewd traders who established patterns for the fur trade that were to extend well into the next century. The aggressive, warlike Tlingit were more than a match for the Russians when they tried to establish a settlement at the present town of Sitka. Many explorers and travelers have left detailed descriptions of these colorful people and their elaborate culture. Spanish drawings and artifacts collected by the Malaspina expedition help give reality to the descriptions of the explorers. The final chapter describes the northern limit of explorations in Prince William Sound, Cook Inlet, and in the vicinity of Unalaska.

The book concludes with two appendices, the first of which lists and describes all known 18th century artifacts from the northwest coast in European collections, as an aid to future ethnohistorians. The second appendix discusses the technological processes of the 18th century with special reference to these artifacts.

Even if Dr. Gunther had done no more than bring together documentary material for the period, she would have made a valuable contribution to northwest ethnohistory. She has, however, done much more. Her carefully researched interpretations provide a truly three dimensional portrait of Indian life. It is a superb scholarly achievement.

by Dr. James W. VanStone, Curator, North American Archaeology and Ethnology, and Chairman, Department of Anthropology, Field Museum.

The Serengeti Lion

By George B. Schaller. Chicago: University of Chicago Press, 1972. xiii + 480 pp. $12.50.

This book is a balanced and meticulously organized treatment of four years of data on the lion, as well as on the species it depends upon and competes with for food. The study is comprehensive. Schaller dispels and verifies some common beliefs, but is careful not to extend himself beyond the time and geographic limits of the study. A lucid and sometimes poetic exposition is documented with 79 appended tables and many fine figures and plates.

Lion society has two strata in Tanzania's Serengeti National Park. Most animals are born into a pride, a relatively sedentary, stable, and closed social group of related animals. A smaller segment of the population consists of small transitory groups of unrelated nomads. Females are centripetal elements of the pride. Food is procured primarily by female pride members, and variations in its abundance apparently control frequency of estrus but not litter size. Any female may nurse any cub within its pride. Cubs depend on adults for food for the first year and a half, and most males become nomadic in another year or two.

Wildebeest, zebra, and Thomson's gazelle compose the bulk of the diet, but their availability varies with season, habitat, and topography. Since only nomads follow these migratory herds, these food species are unavailable to most lions for part of the year. Plains lions scavenge far more than woodland populations, apparently because herds are concentrated and also more vulnerable to other sources of mortality. Stalkers, like the lion, select more randomly from available age classes than do wild dogs and hyaenas, which course down disabled and young animals. Hunting success increases when more than one lion participates, and is greatest where cover permits close approach.

Schaller collected a surprising amount of information on the leopard, cheetah, and wild dog also. His treatment of these and other predators in the third part of the book provides the basis of a comparative discussion of the adaptive relationship between the ecology, social structure, and behavior of the large Serengeti carnivores.

This book does much to promote the study of mammalian carnivores, and such study has wide-ranging significance. While many zoologists and anthropologists feel it "nobler in the mind" to pursue man's societal and communicatory origins by studying non-human primates, Schaller has shown that human social qualities such as cooperation and sharing are emergent properties of a hunting habitus rather than of a primate heritage. Food is an important determinant of social organization, and food is often more easily studied in carnivores than herbivores. In the case of the Serengeti, a comprehension of the predator-prey axis is critical for conservation as well as for scientific reasons.

George Schaller is still a young man and in a league of his own. What large and mysterious species will he study next? Giant Panda?

by Dr. Chris Wemmer, Curator of Small Mammals, Brookfield Zoo.

Alfred Kroeber: A Personal Configuration.

By Theodora Kroeber. Berkeley: University of California Press, 1970. xi + 292 pp.; illustrations; bibliography. $7.95.

Alfred Lewis Kroeber, who was a Research Associate in American Archaeology at Field Museum from 1926 until his death in 1960, was one of the great anthropologists of his time, and his passing marked the end of an era in American anthropology. He was not only a great figure but the last of the "universal" anthropologists in this country. His book *Anthropology*, published in 1923, was the first general textbook in anthropology. His more than five hundred publications included contributions in ethnology, archaeology, linguistics, folklore, historical syntheses that were often of world scope, and numerous papers on the nature of culture. He received his Ph.D. in anthropology at Columbia University in 1901 and taught at the University of California in Berkeley from 1901 to 1946. After his retirement he continued to the end of his life to teach—at Columbia, Harvard, Yale, Brandeis, and Chicago—and to write, edit, and take part in symposia and conferences.

No one is so well qualified to describe Kroeber's personal configuration as his widow, Theodora Kroeber, well known as a writer for her beautiful and moving book *Ishi in Two Worlds* and for *The Inland Whale*, a retelling of northern California Indian myths. She explains in the preface to her biography of her husband that she discovered when working on what began as an *aide mémoire* on Kroeber that there was "no unpatterned miscellaneous way of writing meaningfully of him. To tell anything of him is to become aware of the pattern and the configuration which are at the heart of the person and the personality. This is true, I am sure, of any achieved personality: it is just that Kroeber was more of a piece than many of us, his life pattern deeply cut, cleanly outlined." She does

A. L. Kroeber on First Marshall Field Archaeological Expedition to Peru, 1925.

not attempt to assess Kroeber as an anthropologist and scientist. Rather, she hopes that "what I have written will give some pleasure to those who knew Kroeber well, explain some matters which they never understood; and that for those young anthropologists who never knew him, may suggest some flicker of what he was, of how he got that way, of how deep and vital was his interest in the future. . . . I would like the 'new horizon anthropologists' to know he wished them so very, very well; that he would have so liked to know them and their work."

In addition to being a prolific writer and a great teacher, Kroeber was a museum man. His first field work, among the Arapaho Indians, was sponsored by the American Museum of Natural History. For

many years he was director of the Museum of Anthropology at the University of California. His association with Field Museum began in 1925, when he conducted the First Marshall Field Archaeological Expedition to Peru. The following year he headed the Second Marshall Field Expedition to Peru. During these two expeditions he surveyed the whole Peruvian Coast, made extensive surface collections, and excavated in the Lima, Cañete, and Nazca Valleys. These efforts nearly doubled the Museum's holdings in Peruvian archaeology. As a result of this field work, he published two survey articles in the *American Anthropologist* and four monographs in *Fieldiana: Anthropology*.

Kroeber was a humanist and natural historian rather than a social scientist. Mrs. Kroeber quotes (p. 227) his views on the nature of anthropology and his position in it, expressed late in his career:

"I believe anthropology to consist of three about equal components—natural history, humane and social science. I consider my own motivations and interests to consist overwhelmingly of the first two; I am not really a social scientist at all. I had to reach seventy before I began to discover that, but I think I know it at eighty.

"I have increasingly realized in recent years that I have never been a behavioral or even a truly social scientist, but a humanist with a sort of natural history slant. I am interested in languages, grammars, civilizations, styles, religions, logics—all of which have patterns and forms and are *products* of social behavior but are not behavior themselves. I have really been only incidentally interested in the interrelations and actions of groups of people."

I came to know Kroeber first when I was an undergraduate at Berkeley in 1932 and then in the spring of 1938 at Chicago when he joined four of us in a memorable party celebrating the passing of our "prelims." I knew him more intensely during the last decade of his life. He was a stimulating and generous mentor, a warm friend, and a colleague of wide ranging interests and extraordinary erudition. I recall a conversation in 1938 while driving him to Robert Redfield's farm northwest of Chicago—the subject was the variety and distribution of barn styles in eastern United States. Kroeber had not made a systematic study of barns but had a rich store of observations on the styles in various regions and was interested in the nature and cause of their distributions.

I feel that in this book Theodora Kroeber has succeeded admirably in her hopes, has reflected truly Kroeber's fundamental thinking, and has written a beautiful biography. It will afford pleasure and stimulation not only to anthropologists but also to anyone interested in the American Indian or American intellectual history of the past hundred years.

by Dr. Donald Collier, Curator of Middle and South American Archaeology and Ethnology, Department of Anthropology, Field Museum.

Eyewitness to Space

By Hereward Lester Cooke, with collaboration of James D. Dean. Foreword by J. Carter Brown. Preface by Thomas O. Paine. New York: Harry N. Abrams, Inc., 1971. (Printed and bound in Japan by Toppan Printing Co., Ltd.) 241 pp. (unpaginated). $35.

When Leif, son of Erik, sailed from Greenland on a voyage of discovery to North America, no anxious, cheering crowd saw him off or welcomed him back. Indeed, we have only the spottiest details of his voyage at all. Columbus, 500 years later, fared better (temporarily) as far as public regard was concerned, though even then we have only moderately detailed accounts of his preparation, discoveries, and return. Stanley's explorations of the Upper Nile and the Congo Basin, on the other hand, were reported in considerable detail. It is clear that as time has gone on expeditions of discovery have enjoyed ever better and more detailed documentation, culminating in the several voyages of discovery to the spaces surrounding the earth, and to the moon beyond.

In documenting this, the most recent, example of man's continuing desire to explore the unknown, no detail, however minute, has been omitted. Because the camera is capable of recording stark fact, often devoid of meaning, the National Aeronautics and Space Administration and the National Gallery of Art together commissioned forty-seven of the United States' best artists to record any and all aspects of the venture into space. *Eyewitness to Space* is the result.

Armed with sketchbooks, easels, and media of all kinds, from simple pencils to oils and canvas, these artists trooped through the facilities at Florida's Cape Canaveral, Houston's Manned Spacecraft Center, and over the decks of recovery ships in the Pacific. They were not required to record specific scenes, events, or activities, but to draw what struck their respective fancies or whetted their imaginations.

Just as no concert is completely perfect, or no art showing an absolute success, so too is this book a mixture of the excellent and the average. It contains a total of 289 reproductions of drawings, of which 103 are in color. The format of the book is spacious, with 12-by-16 inch pages. The majority of the originals were larger than this, so most of them have undergone some reduction.

Of the 186 black and white pictures, most were originally done in pencil, or pen and ink. Some were done in watercolor and reproduced in black and white, for what reason it is not clear. True to their assignment, the artists captured a mass of moods, impressions, and details of the men and machines that have assaulted the ultimate physical frontier—space.

Many of the drawings, both black and white and color, record mundane details—launch pads, preparation rooms, an astronaut being hauled into a recovery helicopter, men in Mission Control hunched over monitors, bits of hardware, long views of stretches of Florida beaches. But, like any art showing, sprinkled among these is a goodly number of show-stoppers.

The book is beautifully put together and the color plates carefully prepared, separated, and printed—a typically top-notch production of Harry Abrams' publishing company. As is always the case with quality, the price will limit the number of possible purchasers.

I found the book pleasant to leaf through, though it was not entirely what I had expected. Personally, I would have been pleased with a larger number of pictures of the kinds I have specifically singled out above. There were, I felt, too many of what I would call documentation drawings: rockets being launched, gantries, flight decks of aircraft carriers, and the like.

In any event, whether you are interested in art or not, this collection holds something for you and is worth seeking out in a library if you cannot afford to purchase it.

It is fitting that man's venture into space be recorded in this fashion. It is one of the few times that both the explorers and the mass of mankind have been fully aware of the unusual significance of the exploration. Whatever the future will say about this space program, one thing must stand out: as Astronaut Neil Armstrong has pointed out, it is the first time mankind has ventured into a new, unknown land without sword or gun—surely a hopeful sign.

By Dr. Edward J. Olsen, Curator of Mineralogy, Department of Geology, Field Museum.

All of the books mentioned here are available from the Field Museum Book Shop—with a 10 percent discount to Museum Members, of course.

Liaison Committee of Women's Board Helps Trustees in Capital Campaign

Full and enthusiastic support of the Field Museum Women's Board for the current $25,000,000 Capital Campaign has been assured with the creation of a Women's Board Liaison Committee for the Capital Campaign.

Chaired by Mrs. Corwith Hamill of Wayne, Illinois, those who have volunteered to serve with her are: Mrs. B. Edward Bensinger of Chicago, Women's Board President; Mrs. Leonard S. Davidow of Highland Park; Mrs. Elliott Donnelley of Lake Forest; Mrs. R. Winfield Ellis of Chicago; Mrs. Burton W. Hales of Winnetka; Mrs. John T. Moss of Chicago; Mrs. Paul W. Oliver of Northfield; Mrs. Leo H. Schoenhofen, Jr. and Mrs. John R. Siragusa, both of Barrington; Mrs. Edward Byron Smith, Mrs. Hermon Dunlap Smith, and Mrs. Morrison Waud, all of Lake Forest; and Mrs. William Wood-Prince of Chicago.

According to Field Museum trustees Marshall Field and William H. Mitchell, co-chairmen for the individual gifts division of the Capital Campaign, the Women's Committee is expected to obtain gifts from members of the Women's Board, their husbands, and others.

Mrs. Hamill and her committee are arranging a series of luncheon meetings of small groups in order to acquaint them with the specific work being done in the scientific areas and the specific needs for the Museum's renovation and rehabilitation.

At a recent meeting, Mr. Field congratulated Board members for having made a departure from their stated purpose when the Board was founded in 1966. Although originally public relations and promoting "interest in the Museum and its activities" was its purpose, the Board felt the time has now come to give all the material support possible to Field Museum.

Dr. Matthew H. Nitecki, Associate Curator of Fossil Invertebrates, explains some points about paleontology to Mrs. Corwith Hamill, Mrs. Gardner Brown, and Mrs. Homer J. Livingston when they visited the geology storeroom after a recent luncheon meeting.

Mrs. William Wood-Prince, Mrs. Edward Byron Smith, and Mrs. B. Edward Bensinger visit the cramped and antiquated kitchen facilities of Field Museum's restaurant, which are high on priority list of renovations to be accomplished with Capital Campaign funds.

Mr. Marshall Field discusses with Mrs. Burton W. Hales and Mrs. John T. Moss the important role the Museum's Women's Board is playing in the Capital Campaign.

On an inspection tour of some of the building's critical problems to be corrected with Capital Campaign funds, Museum Director E. Leland Webber explains the sunken ground floor problem to Mrs. Robert C. Gunness, Mrs. Lewis E. Myers, Mrs. Edwin N. Asmann, Mrs. David Mayer, Mrs. George Harry Watkins, Mrs. Hermon Dunlap Smith, and Mrs. W. Press Hodgkins. The building itself has not sunk—it is supported by pilings that extend almost a hundred feet below lake level to rock or other hard substance—but the ground floor has—having been laid directly on land fill; it must be tied into the building structure.

FIELD BRIEFS

Botany Has New Associate Curator

Dr. John J. Engel, recently appointed the Donald Richards Associate Curator of Bryology, is the Department of Botany's newest staff member. He came to the Museum from Michigan State University, East Lansing, where he was a post-doctoral research associate, having received his Ph.D. in 1971. Dr. Engel's current research is on south temperate and subantarctic hepatics (liverworts).

John J. Engel

New Assistant Curator of Fishes

Dr. Robert K. Johnson recently joined the Department of Zoology as Assistant Curator of Fishes. He received his Ph.D. from the University of California (San Diego) in 1971. His dissertation research was on a family of deep sea fishes at the Scripps Institution of Oceanography. In the intervening year Dr. Johnson was a research associate at the University of Maryland, Chesapeake Biological Laboratory, working on the eggs and larval stages of Chesapeake Bay fishes.

Robert K. Johnson

National Science Foundation Grants

Field Museum was recently awarded grants by the National Science Foundation to support two important research projects of its scientific staff for a period of 24 months. One grant of $30,900 is for a study of the taxonomy of the Basidiomycetes, directed by Dr. Rolf Singer, visiting research curator of mycology in the Department of Botany. A grant for $36,100 supports work on the comparative anatomical and phylogenetic relations of the elasmobranch fishes, under the direction of Dr. Rainer Zangerl, Chairman of the Department of Geology.

Give Field Museum to Someone

Remember that a Field Museum membership offers something for the whole family: free admission at all times; previews of new exhibits; the excitement of Members' Nights; the stimulation of workshop programs for children; a discount on purchases at the Book Shop; and the *Field Museum Bulletin* delivered to your mailbox eleven times a year.

There is still time to order a membership as a holiday gift for some special friends or relatives. You could telephone your order directly to the Membership Department. 922-9546. Or you could use the order coupon here. Either way, you would give a gift that would be a lasting reminder of your special thoughtfulness.

For each gift membership an announcement greeting card will be sent in your name plus a portfolio of four color reproductions of bird paintings done by the distinguished American artist Louis Agassiz Fuertes on a Field Museum expedition to East Africa.

Clip and mail to: Field Museum of Natural History, Roosevelt Rd. at Lk. Shore Dr., Chicago, Ill. 60605

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Merrill Trust Gift to Help "Man in His Environment" Program

E. Lee Cotton, Vice President of Merrill, Lynch, Pierce, Fenner & Smith, Inc., recently presented a $50,000 check from the Merrill Trust to Field Museum Director E. Leland Webber, as Dr. Robert F. Inger, the Museum's Assistant Director, Science and Education, looked on. The sum from the Merrill Trust will be matched by a gift from the National Endowment for the Humanities. The funds will be used for a comprehensive public education program, "Man in His Environment." The core of the program consists of a permanent exhibit at Field Museum as well as a traveling version of the same exhibit designed to visit other metropolitan areas. The exhibit opening at Field Museum is scheduled for 1974.

Jade grapes from mainland China.

Museum Has Exotic Holiday Gifts

In the Book Shop you can find jade from the Far East at $4 to $200; a leather shoulder bag decorated with cowry shells made by the Mossi tribe of Africa's Upper Volta; a wall hanging made from a patterned, hand-woven Ethiopian camel blanket; collectors' rock and mineral specimens; African glazed clay trade beads; lacquer ware and coin necklaces from Taiwan; and much, much more, from stocking stuffers to Important Presents—all at a 10 percent discount for Museum Members, of course. Come and see.

CALENDAR

Exhibits

Continuing

Greenland: Arctic Denmark, an exhibit covering all aspects of the history and culture of the world's largest island. The extensive collection of archaeological and ethnological material is supplemented by photographs and a daily film program to illustrate various areas of economic development and social change in modern Greenland. The exhibition is sponsored by the Royal Danish Embassy and is shown under the auspices of the Smithsonian Institution Traveling Exhibition Service. Through March 8. Hall 27.

A New Spirit in Search of the Past: Archaeology and Ecology in the Lower Illinois River Valley, an exhibit explaining the "new" archaeology as reflected in the Illinois Valley Archaeological Program's excavation of the Koster Site, directed by Dr. Stuart Struever of Northwestern University. Through March 25. Hall 9.

Paracas Whistling Jar from the Ica Valley of Peru, Ocucaje Phase II (ca. 700 B.C.), is featured in the South Lounge through January 21. The unique pottery jug, which makes a whistling sound when water is poured out of it, is the earliest known of its type. It is the gift of Mr. and Mrs. Raymond J. Wielgus.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with the physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. Continues indefinitely.

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world and how it functions in plants and animals. Continues indefinitely. Hall 25.

Film and Tour Program

A special series of films relating to the "Greenland: Arctic Denmark" exhibit is shown continuously beginning at the following times:

Daily: 10 a.m. and 1 p.m.
Friday: 10 a.m., 1 p.m., and 6 p.m.
Saturday and Sunday: 11 a.m. and 2 p.m.

Weekend Motion Picture, "The Unexplained," presented at 1 and 3 p.m. Saturdays and Sundays in the second floor North Meeting Room. The documentary film reveals investigations of scientists and amateurs into strange and unexplored frontiers of knowledge.

December 26 through 29

"Through These Doors," a color film focusing on behind-the-scenes activities at the Museum, shown at 1:15 p.m. in the second floor North Meeting Room. A "highlights" tour leaves at 2 p.m. from the north information desk.

Children's Program

Begins December 1

Winter Journey for Children, "Dog Meets Man," a free, self-guided tour exploring the many aspects of man's partnership with "his best friend" since prehistoric times. Youngsters are provided with a questionnaire which routes them through Museum exhibit areas. All boys and girls who can read and write may join in the activity. Journey sheets are available at Museum entrances. Through February 28.

Meetings

December 12: 7:30 p.m., Nature Camera Club of Chicago

December 12: 8 p.m., Chicagoland Glider Council

December 13: 7 p.m., Chicago Ornithological Society

December 13: 7:30 p.m., Windy City Grotto, National Speleological Society

December 14: 8 p.m., Chicago Mountaineering Club

Coming in January

Opens January 10

Below Man's Vision: Electronic Windows to Unseen Worlds, an exhibit exploring the world of details in common objects and familiar plants and animals, and offering glimpses into current research activities. Over 200 photographs, displayed at up to 200,000 times life size, introduce a previously unseen world. Through June 10. Hall 18.

December Hours

9 a.m. to 4 p.m. Monday through Thursday, except 9 a.m. to 5 p.m. December 26 through 28. Friday hours are 9 a.m. to 9 p.m., and Saturday and Sunday hours are 9 a.m. to 5 p.m.
Field Museum is closed on Christmas Day.

The Museum Library is open 9 a.m. to 4 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Museum telephone: 922-9410